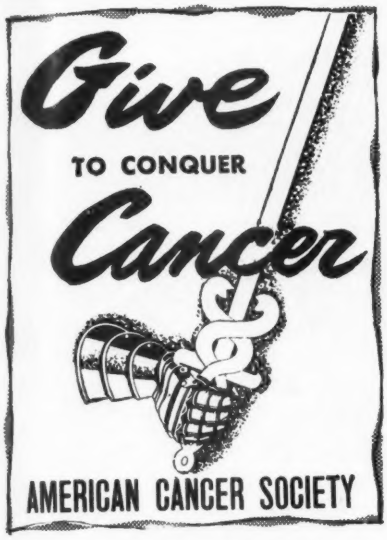


ON THE COVER

ONLY in the Cumberland Basin, at the head of the Bay of Fundy, can you see commercial fishermen harvesting their catch with a team and wagon. This strange spectacle is described in the article that starts on page 127.

•

IN THIS ISSUE

WORTH-WHILE savings in time and, hence, money are made possible in tunnel driving by the use of readily maneuverable booms on jumbos for mounting rock drills. A description of this new construction aid is included in our leading article.

•

WHY it pays to use closed cooling systems on industrial engines and compressors is explained in the article that begins on page 123.

•

VARIED examples of applications of air power are pictured in the spread, *Compressed Air at Work*, on pages 130-31.

•

IN ADDITION to huge quantities of air, many common things usually associated with households enter into the making of steel. Page 132.

•

PRIZE FOR AUTHOR

FOR his article, *Floating Concrete Mixing Plants*, published in our November, 1949, issue, George W. Alexander of Dravo Corporation, Pittsburgh, Pa., received a cash prize from his company. He was one of the winners in Dravo's eleventh annual technical-papers contest.

•

CORRECTION

A MISSTATEMENT in our March issue that could lead to serious consequences appeared in the last sentence of an item on page 79 headed *Weighting the Tires of Tractors*. Writing of the partial filling of pneumatic tires with water to increase traction, we reported that flake calcium carbide is commonly added as an antifreeze in regions where freezing temperatures occur. As any miner knows, this would form acetylene gas and would not deter freezing. Calcium chloride, not calcium carbide, should have been designated.

Compressed Air Magazine

VOLUME 55 — May, 1950 — NUMBER 5

G. W. Morrison, *Publisher*
C. H. Vivian, *Editor* — J. W. Young, *Director of Advertising*
Anna M. Hoffmann, *Associate Editor* — J. J. Katarba, *Advertising Mgr.*
A. W. Loomis, *Assistant Editor* — Joseph C. Dilts, *Advertising Sales*
Walter P. Gillingham, *Assistant Editor*
D. Y. Marshall, *Europe*, 243 Upper Thames St., London, E. C. 4.
F. A. McLean, *Canada*, New Birks Building, Montreal, Quebec.

EDITORIAL CONTENTS

ADVERTISING INDEX

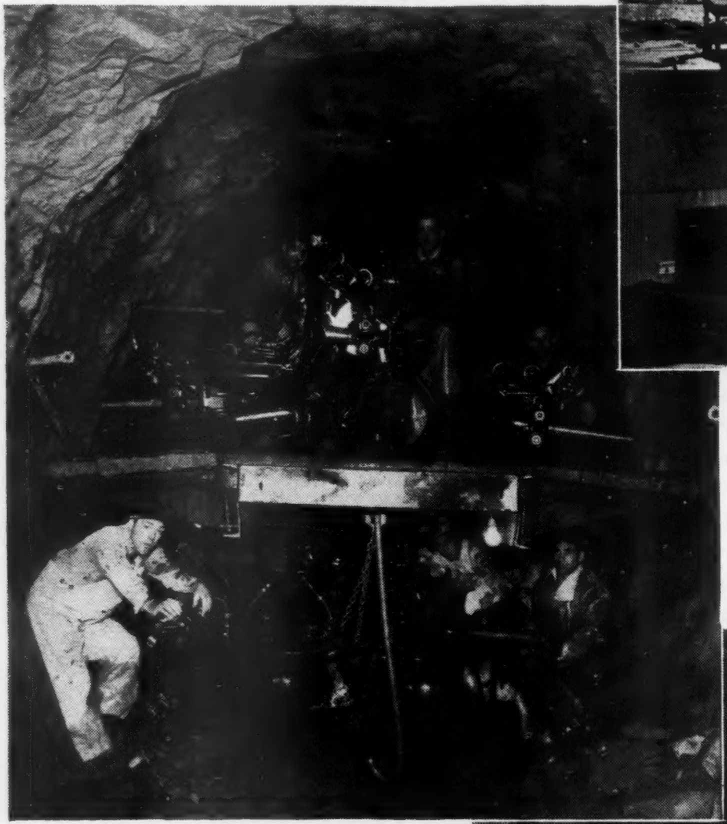
A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit

Published by Compressed Air Magazine Co., G. W. Morrison, *President;* C. H. Vivian, *Vice-President;* J. W. Young, *Secretary-Treasurer.*
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York 4, N. Y., L. H. Geyer, *Representative.*
Annual subscription: U.S., $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

DRILLING IN TUNNEL

The view below shows one of the two large drill carriages built by Frazier-Davis. Five drifters mounted on air-powered booms work in unison to drill approximately 40 holes, each about 9½ feet deep, in 1½ hours. The sump pump hanging from the front of the jumbo removes water that accumulates at the face. Pictured at the bottom is the jumbo as seen from the rear. The boom-mounted drifter on the near end puts in pinholes for securing air and water lines, knocks off projecting rocks, etc. The round, screened object is a fan blower that helps to ventilate the heading while drilling is in progress. The flatcar towed by the jumbo carries drill steel, bits, tools, and spare parts.



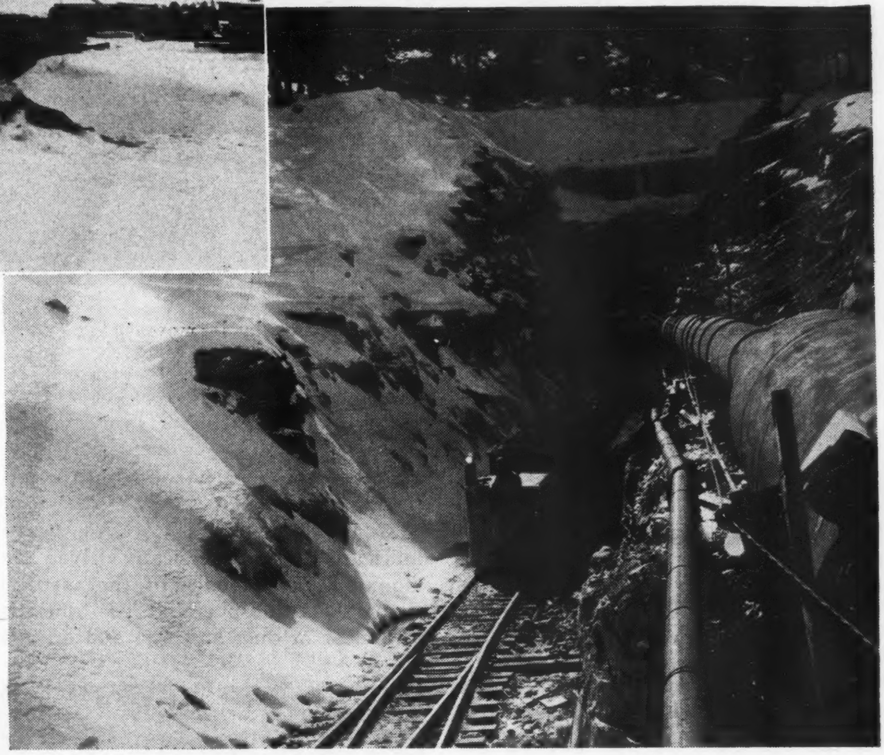
Driving the Neversin

New Catskill Bore Will Carry Water for New York City

WATER conscious New Yorkers, asked by city officials to bathe and shave less, drink no water with their meals, stop faucet leaks, and quit washing their cars, are again looking to the Catskills for long-range relief from the water shortage. On the southern and western slopes of these mountains are shaping up the final phases of the city's New Delaware Water Supply Project that was interrupted by the war. These involve the building of three large interconnected dams that will impound the runoff of watersheds and deliver it to the city through the already completed 85-mile-long Delaware Aqueduct. One of these barriers, the Downsville Dam on the east branch of the Delaware River, will create the Pepacton Reservoir. The Merriman Dam, situated on Rondout Creek at the intake of the Delaware Aqueduct, will form Rondout Reservoir, a body of water 10 miles long. Several miles to the west of the Rondout Reservoir, the Neversink Dam will back up the Neversink River into a 5-mile-long reservoir.

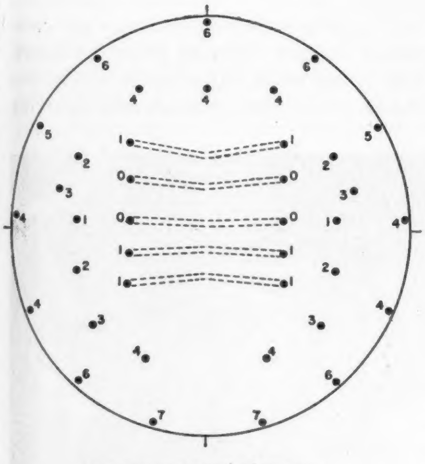
AT GRAHAMSVILLE

The contractor's camp (left) is located a few hundred yards from Grahamsville, N.Y., at the discharge end of the 5½-mile section of Neversink Tunnel. The compressor house is at the left, with machine and blacksmith shops and other buildings on the right side of the tracks that come out of the tunnel. The muck-dumping station is at the far end of the tracks, with the concrete-mixing plant at the right. Just beyond the road can be seen the sheet-steel piling that marks the site of the hydroelectric plant that will be built to serve nearby towns. In the hillside back of the roadway is the portal of the short tunnel section that will carry water emerging from the powerhouse through the intervening ridge to Rondout Reservoir. The steel pipe in the foreground will form a conduit to carry water from the main bore to the powerplant. The picture below shows the Grahamsville portal of the main tunnel section with a loaded muck train emerging.



rsin nnel

W. P. Gillingham



DRILLING PATTERN

Diagram showing a typical drill round in Neversink Tunnel. All holes are drilled straight in except the ten closest to the center, which are angled so as to bottom at the center line of the bore. When the round is fired, the latter holes break first, taking out a V-shaped or wedge cut. The remainder then break into the central space. The numbers indicate the order in which the holes are fired.

To connect the Neversink and Rondout Reservoirs, Frazier-Davis Construction Company, St. Louis, Mo., is driving through nearly 6 miles of rock to form the Neversink Tunnel. Working with specially designed jumbos that carry boom-mounted drifters, its crews are drilling, loading, blasting, and mucking out six rounds every 24 hours in each of two headings for an average daily progress of 50 feet per heading. When completed, the 12½-foot-diameter circular-shaped bore will be concreted to a finished diameter of 10 feet and will carry water from Neversink Reservoir downgrade through a mountain into a hydroelectric plant and then into the tail end of Rondout Reservoir.

The $15,600,000 contract awarded Frazier-Davis in December, 1948, called for a tunnel to be constructed in two sections. One, about 5½ miles in length, has its intake near the village of Neversink, Sullivan County, N.Y., at a point ¼ mile upstream from the Neversink Dam that is now being built. The discharge end is in a valley near the town of Grahamsville, where Frazier-Davis has its headquarters. The other, approximately 1200 feet long, has already been driven through a ridge on the opposite side of the valley to Chestnut Creek which empties into Rondout Reservoir. Other phases of the contract provide for a construction shaft to intersect the main tunnel roughly midway; a water-release tunnel; the building of an intake channel, chamber, and superstructure on the Neversink end of the main tunnel; the laying of a steel-pipe conduit connecting the discharge end with a hydroelectric plant to be erected in the valley; an outlet chamber to take the water emerging from the powerhouse and feed it into the shorter tunnel; and the installation of meters, valves, shutters, gates, and other control equipment.

For driving the Neversink Tunnel, Frazier-Davis designed and built two large, all-welded drill jumbos. Each of these is made of two standard, 36-inch-gauge, mine flatcars fastened together 12 feet center to center with 6-inch I beams and having an upper deck supported by upright 6-inch I beams carrying two 12-inch longitudinal angle beams. Transverse braces are of 4- and 6-inch beams, and the whole structure is further strengthened with ¾-inch steel

SCOOPING UP MUCK

After a round has been drilled, loaded, and fired, a Conway loader moves in to pick up the spoil and dump it into 5-cubic-yard cars. The dipper of the 75-hp. electrically driven machine scoops up the broken rock and tosses it onto a conveyor belt that carries it back to a waiting car. Able to swing its mechanical jaw from one wall to the other, the Conway eliminates hand shoveling in cleaning out the heading.

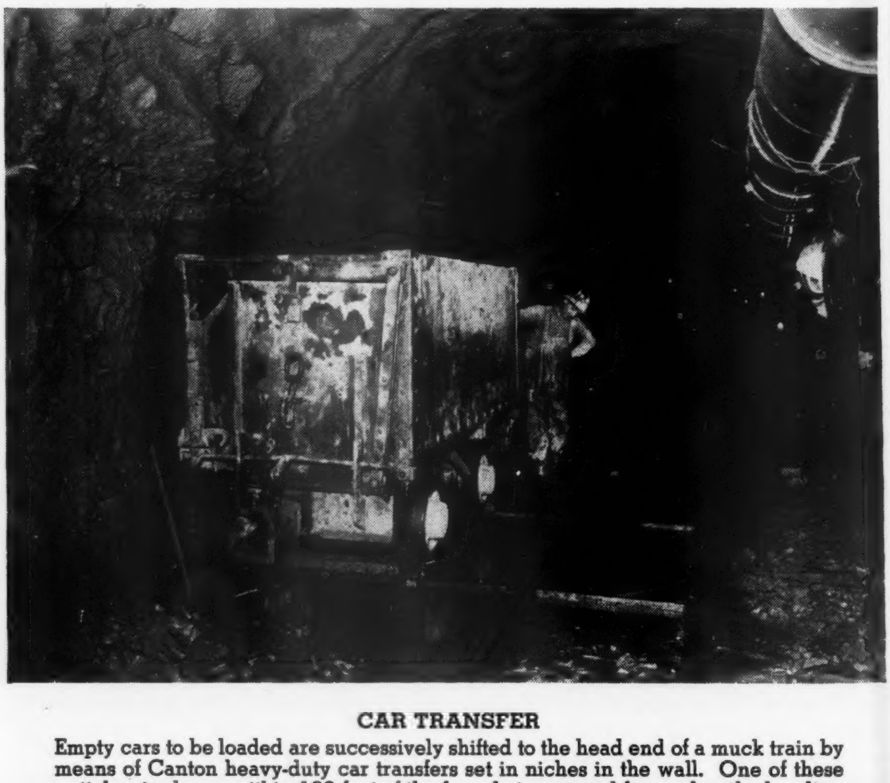
plates at the corners. The upper platform of planking has two collapsible leaves, one on each side, of the same construction. The forward end of the top deck overhangs the lower one by several feet so as to protect the men working there from falling rock, etc.

The over-all length of each carriage is 30 feet. Mounted on the front are five Ingersoll-Rand DJB drill booms—three on the top platform and two on the bottom one—the bases of which are bolted to 1-inch-thick steel plates welded to the deck beams. Each boom is fitted with an I-R DA-35 drifter drill equipped with power feed, a 48-inch aluminum sliding-cone shell, a centralizer for 1¼-inch round steel, and a backhead—a device that automatically supplies the drill with water whenever the air is turned on. Water for drilling is obtained from a well and pumped to a 20,000-gallon tank high up on a hill above the tunnel entrance. From there it is delivered to the machines at 65-70 psi. pressure by aid of an I-R Motorpump interposed in the line leading to the heading.

A sixth boom-and-drill combination is at the back of the upper platform and is used for trimming overhanging rock, drilling pinholes for air, water, and power lines, and for other miscellaneous purposes. Running the length of the jumbo on the lower deck are a 3-inch water line on the left side and a 4-inch air line on the right from which water and air are fed to the booms for distribution to the drifters by pipes and hoses. An Ingersoll-Rand manifold lubricator, placed directly behind each boom, introduces the correct amount of oil into the air going to each machine to assure proper lubrication. An electrically driven fan mounted on the back of the carriage keeps the atmosphere at the working face clear of dust and fog, and an I-R Model 25 sump pump, suspended underneath the front part of the lower deck, removes water from drills, seepage, etc., that may accumulate there. There is a powerful floodlight on the top platform to illuminate the face while the crews are advancing. A flatcar with side and end boards is towed behind the jumbo to carry drill steel, bits, and other supplies. It is fitted with partitions to keep different lengths of steel separate and to facilitate handling.

The boom which serves as a mount for each drifter is powered by an air motor. At the touch of an operating lever, the motor drives a screw feed that quickly and smoothly raises or lowers the boom to bring the machine into position at the working face. Loosening a clamp at the base of the boom permits the latter to be swung so as to move the drill laterally, and a similar clamp on the front end enables the supporting bar to be swung so as to line the drifter up with the hole. All controls for both boom and drill are grouped at the front of the former. The arm cannot creep or settle when in operation because its screw drive assures a positive lock in any drilling position.

The time needed by Frazier-Davis crews to drill, load, blast, and muck out a round in the tunnel is about four hours, divided as follows: drilling, 1½ hours; loading and shooting, approximately 45 minutes; and mucking, 1¾ hours. The average depth of the round pulled is 8 feet 4 inches, and six of these are completed in each heading every 24 hours. The crews work three shifts a day five days a week. Eating lunch and changing



CAR TRANSFER

Empty cars to be loaded are successively shifted to the head end of a muck train by means of Canton heavy-duty car transfers set in niches in the wall. One of these switches is always within 100 feet of the face, being moved forward as the heading advances so that mucking can proceed as soon as possible after firing.

MUCK DISPOSAL

Muck trammed from the tunnel is dumped from cars into storage bins and then withdrawn into trucks for disposal. The inside view of the unloading station shows an operator (right) tilting a side-dump car by means of a 10-inch air cylinder fitted with a flange to engage the underside of the car. The man opposite is holding an air hose with which to clean out any muck remaining in the car after its load has been discharged.

shifts is done in the time it takes to clear the smoke from a heading after a blast.

As soon as the last train of muck from a shot leaves a heading, the jumbo is moved up to the face and drilling begins. The rock through which the tunnel is being driven is the Catskill formation of graywacke sandstones and shales. It is of medium hardness, uniform in composition and structure, and fairly easy to penetrate. A V-cut round of 36 to 40 holes is drilled, using detachable bits in 2-, 1⅞-, and 1¾-inch sizes. Three lengths of drill steel are utilized: 4, 8½, and 11 feet. The holes are loaded with 290 pounds of Atlas Gelamite and Hercules Hercomite and blasted with seven delays of electric blasting caps. Meanwhile, the carriage has been moved back to a switch or "runaround" carved in the tunnel wall so that other traffic can come in to clean the heading when the smoke has cleared.

Mucking is done with Conway loaders, each powered by a 75-hp. electric motor which, through planetary gears, controls all its functions: moves a boom and dipper that scoops up the muck, operates a 28-inch-wide belt that carries the rock dumped on it by the dipper to the rear of the machine and discharges it into a car, and regulates the forward and reverse speeds of the mucker. Power for the latter is brought into the tunnel at 2300 volts and stepped down by transformers, located every 1000 feet, to 440 volts.

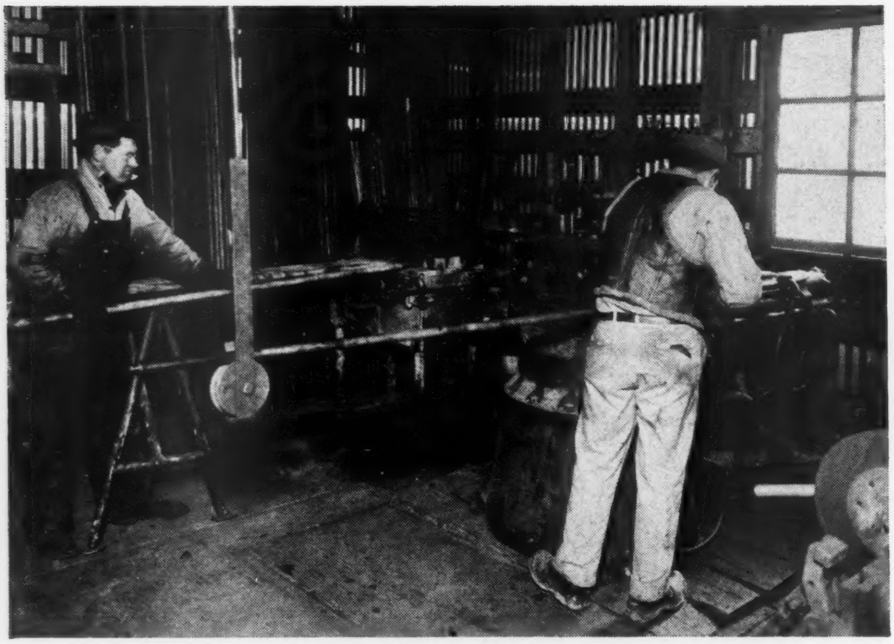
Muck cars are of the Watt 5-cubic-yard side-dump type and are made up in trains of seven or eight moved by 12-ton Greenburg "Cruiser" battery-type locomotives. About two trains are needed to remove the material brought down by each shot. As fast as a car is filled it is shifted from its position at the rear to a spot directly behind the locomotive after the latter has pulled the train to a heavy-duty Canton car-transfer set in a niche in the tunnel wall. The string of cars is then pushed back to the mucker. These operations are repeated until all the empties are loaded. The muck trains, Conway loaders, and drill jumbo travel on 60-pound rails each 30 feet long spiked to ties resting on the tunnel floor. Near the face they advance on temporary tracks made up of 7½-foot sections which are replaced by permanent trackage after reaching a length of 30 feet. The latter is laid during the drilling cycle.

To protect the workmen from falling rock, the tunnel roof is gunited as work progresses, night crews with Cement Gun Company pneumatic equipment following the two daytime shifts and working to within about 30 feet of the face. A 3:1 mixture of sand and cement is used and sprayed on the roof from spring line to spring line in a layer approximately ½ inch thick. This is the practice only in stretches where rock conditions are suitable for this treatment; but where the ground is bad, steel ribs on 4-foot centers, with steel cross members in between, are placed to hold up the roof.

At each end of the bore is a dumping station, designed and built by Frazier-Davis, by which muck is transferred speedily and efficiently from cars to rear-dump trucks. Each consists of an enclosed track or trestle that projects out over a roadway. Underneath the former are six bins lined with steel plates and equipped with discharge gates controlled by air cylinders, two to a gate. A 10-inch pneumatic cylinder suspended from a trolley traveling on an I beam serves to dump the muck from the cars into the bins.

When a loaded train has been run onto the trestle, an operator loosens a safety catch on the side of each car while another hooks an attachment, fastened to the piston of the 10-inch cylinder, underneath the opposite side of the car and turns on the air, tilting the car gradually at first under the steady pressure of slowly admitted air and then rapidly jolting it by intermittent air blasts to clean it out when nearly empty. Other valves manipulated by the cylinder operator open and close the discharge gates on the bins to load the muck into 12-cubic-yard rear-dump Euclid trucks that haul it to a fill area. Meanwhile, his fellow worker cleans out the car and dresses down the sides of the bin with jets of air from an air hose fitted with a length of pipe.

Compressed air for the pneumatic cylinders at the muck stations, the booms on the jumbos, the drills, and for many other services around the camp is supplied by five Ingersoll-Rand Type XVH



BLACKSMITH SHOP

Operators making up lengths of drill steel from stock. The man on the left is heating several lengths of 1¼-inch hollow, round steel in a No. 27F oil-burning furnace, while the one on the right is forging a shank on a rod by means of a No. 54 drill-steel sharpener.

2-stage synchronous motor-driven units each having a capacity of 1200 cfm. Three are housed at the Grahamsville end of the tunnel and two outside the Neversink portal, where one more is to be added. Each plant includes an aftercooler from which the air is delivered into a receiver, 66 inches in diameter and 18 feet high, whence it is fed into a 6-inch pipe line running into the tunnel. Pressure of the air at the drills is about 100 psi.

When Frazier-Davis started driving the Neversink Tunnel its crews also sank the Wynkoop Shaft for construction purposes to the tunnel line. It is circular in cross section, 375 feet deep, and has been concreted to a finished diameter of 14 feet. It was excavated with J-50 Jackhamers using 1-inch detachable steel bits; and Motorpumps, rigged as sinkers, were used to unwater the shaft while work was in progress. A 500-cfm. Mobil-Air compressor furnished the air.

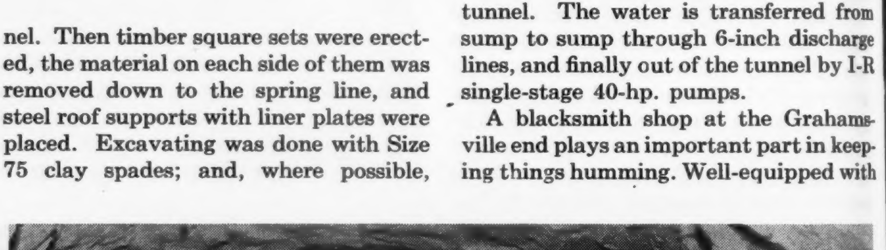
The shorter section of the Neversink Tunnel presented some difficulties because the stretch leading from the powerhouse site into the ridge that separates the site from Chestnut Creek penetrated soft ground for approximately 375 feet. About 190 feet of it was open-cut excavation; the remainder tunnel. In the latter section the formation above the springing line was soft ground, consisting of sand and gravel, with hard rock below. The method of tunneling there was as follows:

An opening about 4x5 feet in size was driven the full length of the area, with the bottom level with the spring line and the top on a line with the arch of the tunnel. Then timber square sets were erected, the material on each side of them was removed down to the spring line, and steel roof supports with liner plates were placed. Excavating was done with Size 75 clay spades; and, where possible, spiling was driven ahead to hold the walls and roof. The lower section of the tunnel was taken out as a bench, down holes being drilled with J-50 Jackhamers.

Except for the stretch near the portal, operations at the Neversink end of the main tunnel are about the same as those on the Grahamsville end. There it was necessary to make an open cut about 145 feet deep before the bore could be started. Four Ingersoll-Rand FM-2 wagon drills mounting X-71 drifter drills and using detachable steel bits were used to take out the cut in lifts of 15 to 16 feet, the muck being loaded into Euclid dump trucks for removal. Trouble was also experienced in this heading at the working face.

From the Grahamsville portal the tunnel is driven upgrade, giving that end natural drainage. However, as the Neversink portal is at a higher elevation, that heading goes downgrade, causing water from the drills, seepage, etc., to collect at the face, hampering operations. Sump pumps, including the one on the front of the jumbo, remove the water from the heading as fast as it accumulates and deliver it to one of the permanent sumps that are dug about every 1000 feet in the tunnel. The water is transferred from sump to sump through 6-inch discharge lines, and finally out of the tunnel by I-R single-stage 40-hp. pumps.

A blacksmith shop at the Grahamsville end plays an important part in keeping things humming. Well-equipped with



SMALL DRILL CARRIAGE

For driving the 6x7-foot water-release tunnel that is a part of its contract, Frazier-Davis designed and built the jumbo shown here at work trimming projecting rock from the walls of the already completed short section of Neversink Tunnel. The jumbo carries two Ingersoll-Rand DA-35 drifter drills mounted on DJB air-powered booms. A third will be added when the water-release tunnel is started.

a drill-steel sharpener, oil furnace, cutoff machine, shank grinder, and pedestal grinder, it cuts, shanks, and threads all drill steel from 1¼-inch round, hollow stock and sees to it that the rock drills on the job are in good running order. Also located outside that portal is a machine shop containing a 200-ton press, lathe, milling machine, drill press, etc., as well as a complete welding shop. The air cylinders for the muck-dumping stations were built there.

Because the 6x7-foot water-release tunnel which is to be driven some 1300 feet from the Neversink end of the main bore to the diversion tunnel that goes around the easterly end of Neversink Dam will not take the large drill jumbos, Frazier-Davis men designed and built a smaller model that differs from its big brothers only in that it has but one deck and no collapsible sides. It is provided with three drill booms carrying DA-35 drifters and with a Model 25 sump pump. As it will be advanced from just one heading, mucking will be done by an Eimco Model 40 Rockershovel loading into 2½-cubic-yard "battleship" buckets. These will discharge into side-dump cars that will be hauled to muck bins.

Concreting of the Neversink Tunnel will begin as soon as excavating is finished, which should be sometime around the last of December. A batching plant has already been set up on the property, and there are bulk-cement storage silos about 13 miles away from which the material will be delivered by truck. Two 1-cubic-yard stationary mixers will draw cement and aggregates from bins, then dump the concrete into cars that will be pulled into the tunnel by the battery locomotives. The arch will be poured first and then the invert.

SOURCE OF AIR

One of the Ingersoll-Rand XVH compressors that supply air at a pressure of 100 psi. It is driven at 360 rpm. by a 440-volt synchronous motor and has a capacity of 1200 cfm. The surmounting intercooler cools the air in two stages between the vertical low-pressure cylinder and the horizontal high-pressure cylinder. This unit is one of two on the Neversink end, where a third is to be added. There are three similar machines on the Grahamsville end.

Neversink Dam is being constructed by S. A. Healy Company of Chicago, Ill., in a deep, steep-sided valley in which the bedrock is overlain with 100 to 150 feet of irregularly deposited sand, gravel, boulders, and clay in various combinations. Like the Merriman and Downsville dams, it is an earth-fill structure with a concrete cutoff wall set in bedrock; and it will have a spillway founded on rock. The structure will be approximately 200 feet high, 2800 feet long at the crest, 1500 feet wide at the base and 60 feet at the top. The dam will call for the use of about 7½ million cubic yards of compacted soil surfaced with one million cubic yards of rock. The reservoir it will create will be some 5 miles long, ½ mile wide, and have a storage capacity of 35 billion gallons. During the period of construction the stream will be handled by the cofferdam and diversion tunnel.

The Neversink intake chamber, which will have a granite-faced superstructure, will be equipped with the necessary stop shutters, gates, valves, meters, etc., to control the flow of water into the Neversink and the release-water tunnels. Provision will also be made for the chlorination of all water passing into the Neversink Tunnel. Two stilling chambers are to be excavated in rock adjacent to the lower part of the intake chamber. These will be approximately 45 feet long, circular in cross section, and lined with concrete to a finished diameter of 8 feet. On the Grahamsville end of the tunnel there will be a 9-foot-diameter steel conduit lined with 6 inches of concrete and enveloped with reinforced concrete. It will convey the water from the tunnel to the powerhouse in the valley. The penstock will be anchored in the Neversink Tunnel by a 1050-foot steel-pipe extension.

Because there is a 600-foot difference in elevation between the Neversink and Rondout reservoirs it was possible to plan for a power plant at Grahamsville. Like the Delaware Aqueduct, the Neversink Tunnel will be a pressure tunnel, conducting water from a high to a lower basin under the force of gravity. The diameters of the different sections of the aqueduct were determined by the difference in head between the two reservoirs and are such that the pressure (head) over and above that needed to feed the water from the upper to the lower reservoir is dissipated by frictional resistance offered by the walls. That is why the diameter of the Delaware Aqueduct varies from 13 feet 6 inches at the intake to 19 feet 6 inches at the discharge end.

However, it is not possible to do this in the case of the Neversink Tunnel because there is an excess head of approximately 550 feet. To dissipate it in the short distance available would require a conduit having a diameter of about 3 feet. The 10-foot-diameter Neversink will dissipate only about 110 feet of this excess head; the remaining 440 or so feet will be used to drive a Francis turbine which, in turn, will drive a 25,000-kw. generator with an output of 13,800 volts. The plant's substation will have three 10,000-kva. transformers, and it is expected to produce 48,000,000 kw-hrs. annually. The electric power thus generated will be distributed to surrounding

communities. Central Hudson Gas & Electric Corporation will operate the station, which will be New York State's first combination water-supply and hydroelectric installation.

Frazier-Davis is one construction firm that has proved that speed in tunnel driving need not be accompanied by increased hazards to its workmen. The company has a favorable accident record, and is doing everything possible to maintain it. This fine showing is largely attributable to its safety program, which sponsors contests. If a crew of a particular heading goes through a month without a lost-time accident, its shift boss gets a bonus. The contest is on a month-to-month basis, and since its inauguration has cut accident rates by an estimated 25 percent. But let the figures speak for themselves:

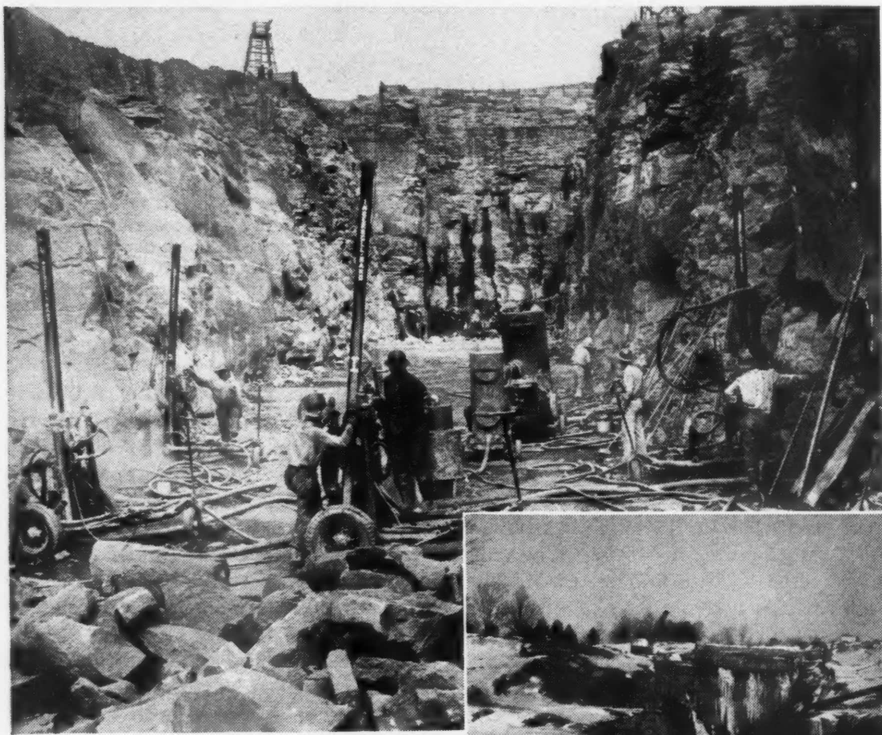
In September, 1949, before the contest got underway, the frequency of accidents per 1,000,000 man-hours was 156.2 and the severity rate per 1000 man-hours was 1.6. In November, with the program in force, the frequency figure dropped to 70.9 and the severity rate to 0.3. In December they were 85.1 and 0.8, respectively; and in January of this year, 68.7 and 1.3. The average number of man-hours worked monthly on the job by company crews is around 60,000.

In the case of Frazier-Davis, there is good coöperation between shift bosses, safety engineers, and management, and every man in a heading is assigned a special job and knows how to do it in a way to avoid accidents. Every new man is carefully briefed in the matter of safety before he reports for work. Tunnel-work rules such as the wearing of hard hats, the use of safety equipment, no smoking, no riding on the front or sides of locomotives, etc., are closely observed. They even include the appearance of the tunnel, where absence of loose sticks, timber, stones, and rubbish on the floor and track are insisted upon. Tests to determine the presence of gas are made periodically.

The safety staff has found out that the use of drill booms on jumbos has led to fewer smashed or crushed fingers, hernias, etc. This is because the crews do not have to exert much physical effort to swing the drills from side to side, and hardly any to raise or lower them. Working with pinch bars and other similar tools has been greatly reduced, together with the accidents incident to their use.

The Neversink Tunnel will be finished in 1952, the year in which the Neversink Dam will be completed. Water from Neversink Reservoir will then begin to pour through the tunnel and hydroelectric station, reaching Rondout Reservoir to swell its contents by some 105 million gallons a day. When the three reservoirs of the New Delaware Water Supply System are in operation sometime in 1955, they will be able to pour into the intake of the Delaware Aqueduct around 540 million additional gallons of water daily. Although not meeting in full the needs of New York City, it certainly will go a long way towards slaking its almost insatiable thirst which demands 1204 million gallons of water a day.

A. W. Frazier is president of Frazier-Davis Construction Company, Roy J. Gunther is project manager, Ted McCoy is field superintendent, W. H. Robertson is night superintendent, John Johnston is field engineer, George Patrick is electrical superintendent, Ed Kastuck is safety engineer, and Hite Riggs is master mechanic. On both the Neversink dam and tunnel jobs Frank J. Musso is division engineer for the New York City Board of Water Supply, Arthur E. Hilliard is senior section engineer, Ellsworth B. Willis is section engineer at the Neversink end of the tunnel and John G. Mergott at the Grahamsville end, and William Sullivan is safety engineer.

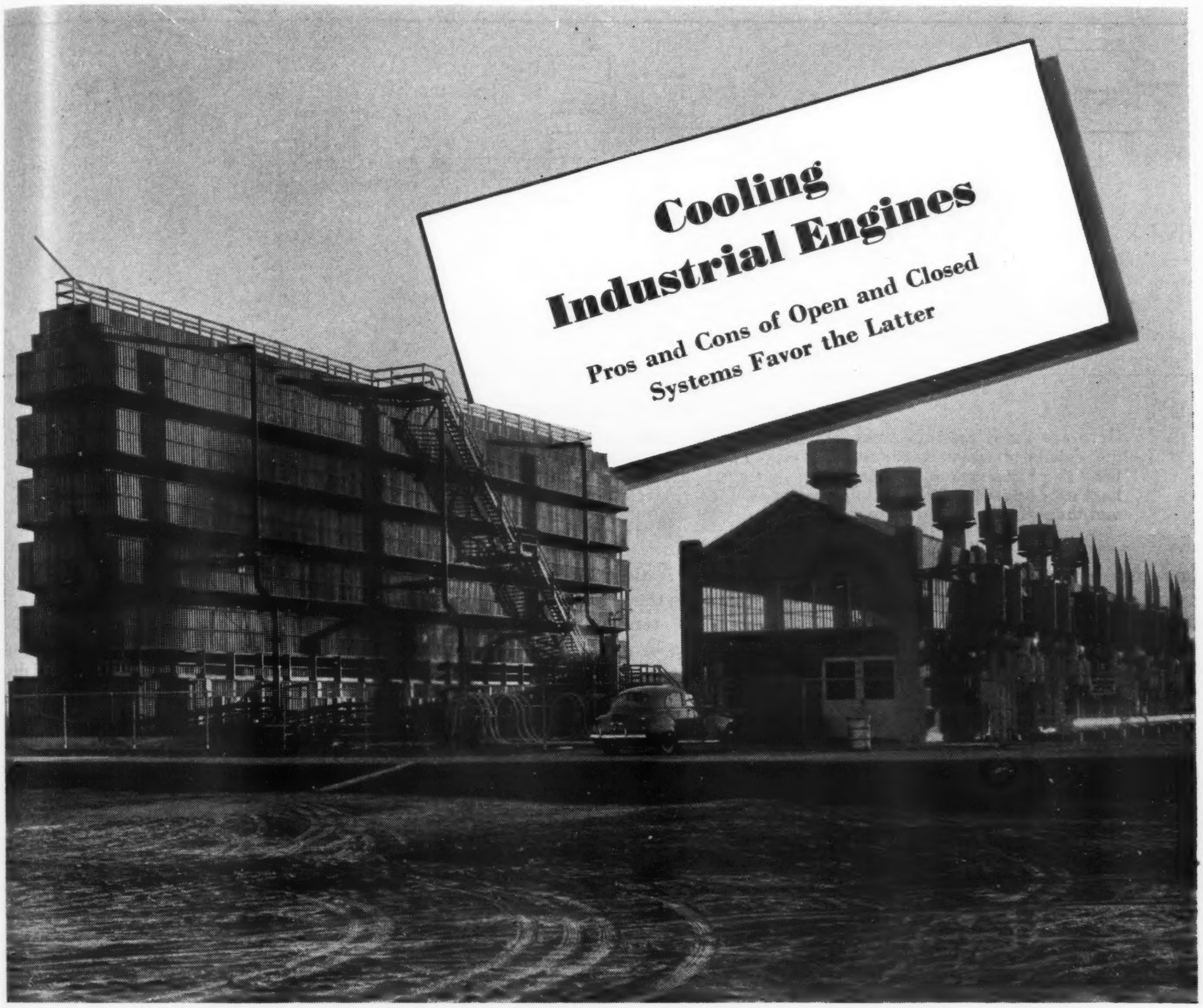


ON THE NEVERSINK END

Before the Neversink portal of the tunnel could be opened up it was necessary to make a narrow cut some 145 feet deep. Shown at left are the four FM-2 wagon drills that were used to take out the rock in a series of lifts. The completed cut and tunnel portal are seen below. When finished, it will have a granite-faced superstructure, stilling chambers, and valves and other controls necessary to regulate admission of water to the bore.

Cooling Industrial Engines

Pros and Cons of Open and Closed Systems Favor the Latter



COOLING TOWER

Cooling towers of massive size are common in oil fields. Pictured here is a Fluor atmospheric-type tower. Some of the raw water flowing over it evaporates and cools the remainder which, in turn, cools water in a closed system that circulates through the jackets of gas-engine-driven compressors in the gas-cycling plant at the right.

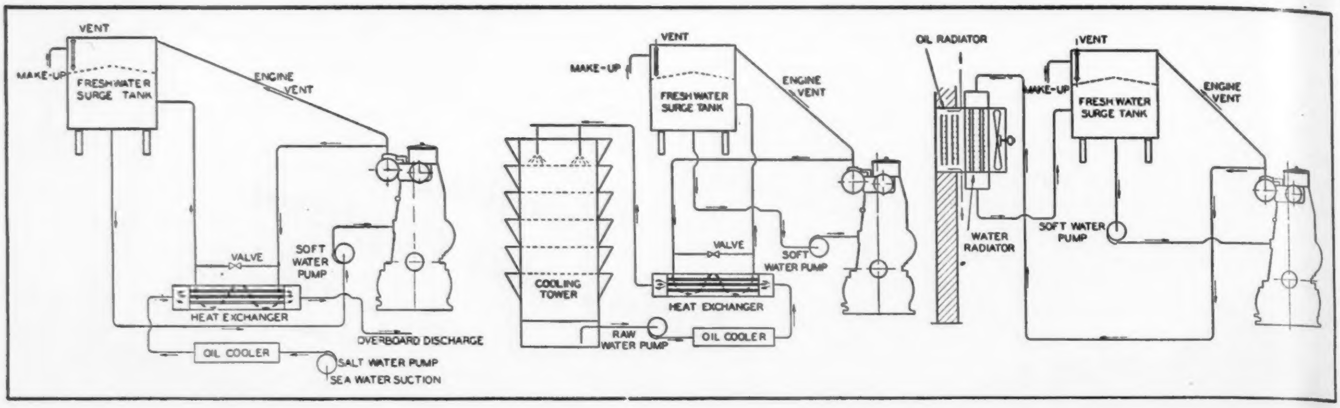
THOUGH it is true that the internal combustion engine converts but a relatively small percentage of the fuel it burns into useful power, it excels the venerable steam engine in this respect. The diesel is the best performer among the prime movers, but even it has an efficiency rating of only 35 to 40 percent. In all cases, the heat from the unproductive part of the fuel must be dissipated. Generally, half of it, roughly, goes out of the exhaust pipe; the remainder is absorbed by the circulating cooling water.

There are two general types of cooling-water systems for industrial engines: open and closed. They differ mainly in the way the cylinder-jacket water is cooled between circuits. Open systems are generally slightly lower in first cost, and of all these the oldest and simplest arrangement is that in which the water is pumped through the cylinder jackets, where it absorbs heat and is then wasted. In another open-type system the water is recirculated instead of being discarded. It is cooled by running it over a cooling tower or discharging it through nozzles into a spray pond. Make-up water is added as required to compensate for evaporation.

Closed cooling systems ordinarily have two water circuits. In one of them soft water, with controlled characteristics, is continually recirculated through the engine cylinder jackets and absorbs heat. The other is an open raw-water circuit that regulates the temperature of the water in the closed circuit by extracting between cycles a percentage of its heat in some form of heat exchanger. The raw water, if plentiful, may be partially or entirely wasted, but generally it is also recirculated and cooled between cycles in a cooling tower or spray pond. Where water is scarce, the raw-water circuit is sometimes dispensed with and the water in the closed circuit is cooled by passing it through a radiator. In oil fields, crude oil is occasionally used to cool the jacket water.

The function of the cooling system is not just to keep the engine cold but to maintain the most desirable operating temperature. Every automobile driver knows that his car doesn't run smoothly until the engine has become "warmed up," and he is fully aware that disastrous results may follow overheating. The same conditions apply to industrial engines (also to compressors), so it pays to give careful attention to their cooling systems. Oftentimes the selection of the so-called "cheapest" really turns out to be highly expensive.

When an industrial engine runs much above the most desirable operating temperature, oil films on moving parts break down, heat distortion may cause pistons to seize, and the engine may break down or wreck itself. When scale-forming water is used, a part of the trouble may



TYPICAL ENGINE COOLING SYSTEMS

Here are three possible arrangements of closed systems, the details of which vary with the supply of raw water. Left– A marine system in which sea water is run through a heat exchanger to cool the soft jacket water each circuit and then discharged overboard. Center– In this case the raw water is cooled each cycle by passing it over a cooling tower. Sometimes this is done by discharging it into a spray pond. Right– Where water is scarce, it is used only in the soft-water circuit. It is cooled every cycle in a fan-type radiator, which also cools the lubricating oil.

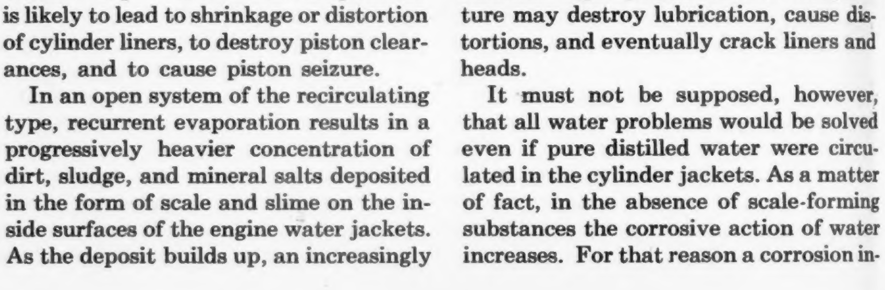
be traceable to the deposition of scale in cylinder jackets. The most serious objection to scale is not that it plugs the water passages (which it does), but that it slows down the transfer of heat from the cylinders to the cooling water and thereby increases an engine's tendency to overheat. As temperature rises, the rate of scale formation increases. This fact formerly led manufacturers to design engines that would run at relatively low temperatures. Comparatively cold water was used because it was circulated slowly, and cylinder-liner temperatures were in reality higher than was indicated. Modern engines have better designed cooling systems in which the water is circulated at high velocities.

Low temperatures will not, however, end the troubles. Although they may eliminate severe scale deposition, equally undesirable mud and rust may be deposited in the water jackets if an engine is operated at much below the optimum temperature. Besides, low temperatures should be avoided because they may cause sludging of the lubricant or the formation and deposition of lacquer derived from the oil, with a consequent increase in cylinder-liner wear in some types of engines. Furthermore, when the jacket water is too cold, the high temperature difference between it and the cylinder walls sets up internal pressures and stresses that are sometimes sufficient to crack an engine block. For these and other reasons most engine builders specify a "best" temperature range in which their engines should be run.

If every plant using industrial engines had handy a river or lake of soft water that would always be at the optimum temperature, cooling would present no difficulties and the open system would be the universal choice. Unfortunately, many are located where the supply is limited, and most water available has at least two things wrong with it: it is corrosive and carries scale-forming matter. But even if it did not cause corrosion or deposit scale there would still remain the problem of temperature control. A sudden drop in inlet-water temperature is likely to lead to shrinkage or distortion of cylinder liners, to destroy piston clearances, and to cause piston seizure.

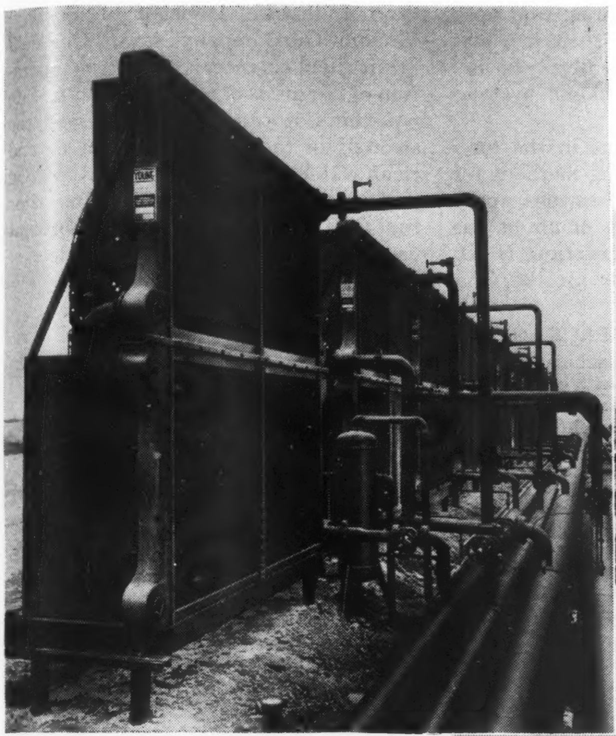
In an open system of the recirculating type, recurrent evaporation results in a progressively heavier concentration of dirt, sludge, and mineral salts deposited in the form of scale and slime on the inside surfaces of the engine water jackets. As the deposit builds up, an increasingly high temperature difference between the water and the inside of the cylinders is needed to dissipate the engine heat. The resultant high cylinder-surface temperature may destroy lubrication, cause distortions, and eventually crack liners and heads.

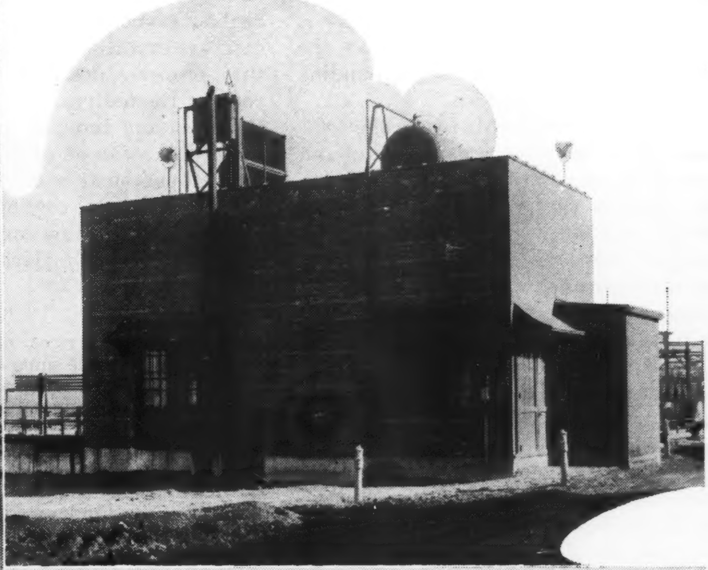
It must not be supposed, however, that all water problems would be solved even if pure distilled water were circulated in the cylinder jackets. As a matter of fact, in the absence of scale-forming substances the corrosive action of water increases. For that reason a corrosion in-

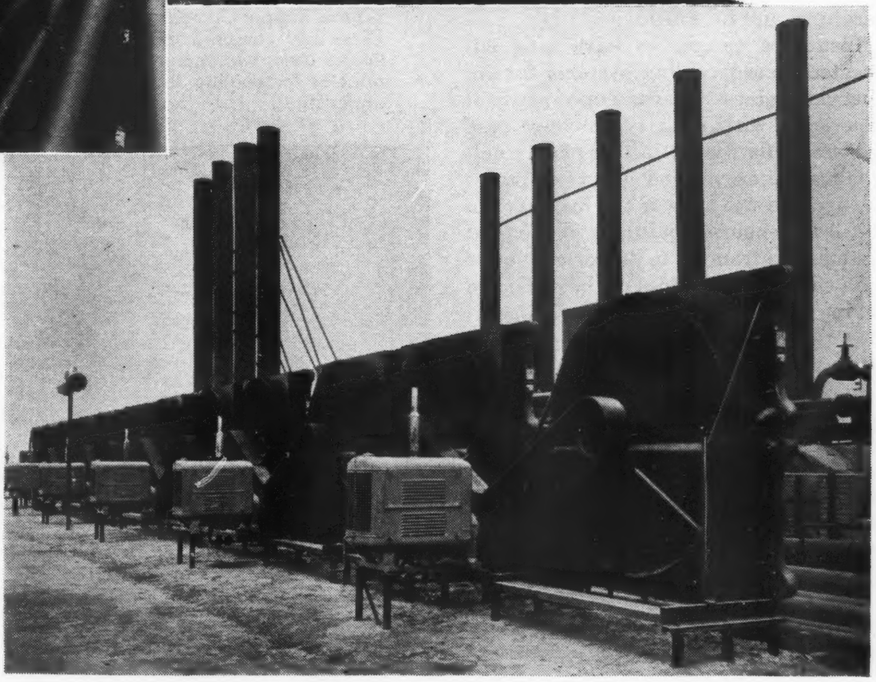


TYPICAL INDUSTRIAL DIESEL

A centrifugal pump normally circulates water through the cylinder jackets. In the case of the Ingersoll-Rand 600-hp., 8-cylinder unit shown here, the pump is mounted on the near end (round object below center at left connected with large vertical pipe). It is driven through gears by the engine crankshaft. The water is directed upward and around each cylinder at high velocity, describing a course that gives complete coverage and prevents unequal heat stresses, hot spots, and the formation of steam pockets.







RADIATOR COOLERS

Except for their size, radiators for industrial engines are similar to those mounted on the fronts of automobiles. They are most used in warm or temperate climates and are generally stationed outdoors to take advantage of cool air and atmospheric currents. Most of them have separate sections for cooling circulating jacket water and engine lubricating oil. Shown at the upper-left is a bank of Young radiators in an oil field. Back of each section is an engine-driven fan (lower picture) to draw air through the openings. Where there is considerable wind subject to frequent changes in direction, natural air currents might offset the fan effect. For that reason radiators are sometimes assembled in the form of a hollow square, with a fan mounted on top to draw air inward and upward. The view at the upper-right shows a radiator on a building that houses a diesel-engine-driven generator. Because the location is one in which freezing temperatures prevail during several months of the year and the unit is operated only intermittently, antifreeze is added to the circulating water.

hibitor must be added to it when it is used in a closed circuit. A popular one is mineral oil that has been processed to make it soluble in water.

In one place in Central America a fruit company is obliged to distill its diesel-engine cooling water because the available supply is unsuitable for the purpose. The water is treated in a unique evaporator which utilizes exhaust heat from an engine. The installation is said to be highly efficient. But, in order to overcome the corrosive effect of the pure water, enough soluble oil is added periodically to maintain a concentration of about 1 percent in the system at all times.

"Another serious trouble that has been experienced with the use of the recirculating type open systems," writes H. J. Vander Eb, assistant chief engineer of the Turbine & Engine Division of the Hartford Steam Boiler Inspection & Insurance Company, "is the obstruction of the piping and water passages through the jackets by foreign material such as lint and dust from manufacturing processes. Such material drifts into spray ponds and open receptacles under cooling towers."

The foregoing discussion makes it plain that the best operating conditions can be obtained by using cooling water of relatively high temperatures. Its advantages can be realized, and at the same time scale, slime, and rust can be avoided by employing a closed system in which a small quantity of comparatively soft water is recirculated. Accordingly, most industrial engines are equipped with closed systems. Although these are not hermetically sealed, evaporation loss of jacket water is inappreciable, the temperature of the inlet water can be controlled economically, and scale and sludge deposits can be minimized by chemical treatment. But because the comparatively small amount of water in the closed circuit would otherwise soon be of the same temperature as the engine, the jacket water itself has to be cooled. That is the sole purpose of the raw-water or secondary circuit.

The quantity of water needed to keep an engine operating at its optimum temperature depends upon several things: the size and kind of engine, the permissible temperature rise throughout the engine, the rate at which the water flows through the jackets, the type of cooling system, and the temperature of the cooling water if a raw-water circuit is used. Even the climate and the day-to-day

weather must be taken into consideration in planning such a system because it is not possible to cool water below the wet-bulb temperature of the surrounding air.

There is no relation between the temperature of the entering jacket water and the rise in temperature of the water passing through the engine. The general trend today is towards higher operating temperatures, and many engine designers maintain that cylinder-liner wear is almost zero at temperatures above 195°F. With what is known as the vapor-phase method, cooling is brought about by passing the water through the engine under pressure. When the pressure is released as the water discharges into a surge tank, some of it evaporates and this cools the remainder. Engines designed for vapor-phase cooling have been operated successfully with water temperatures up to 240°F.

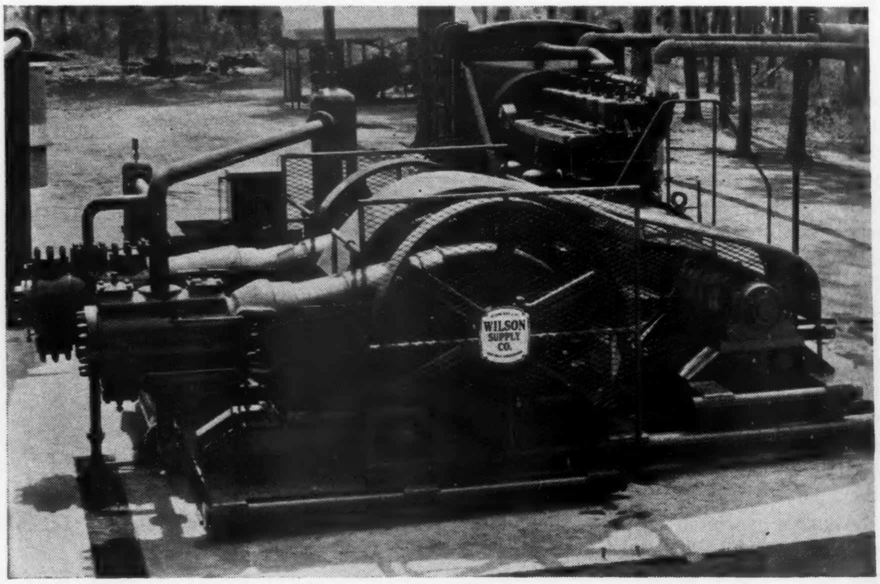
Insurance companies have long advocated closed cooling systems for industrial engines. Drawing upon years of experience with both types, they base their rates for the protection of internal-combustion engines on just two things: the age and the type of the installation. Rates for engines equipped with closed systems are from 17 to 40 percent lower than those for machines of the same age having open systems. From the operator's point of view, however, insurance rates are probably not as important a factor as is more freedom from repairs and maintenance.

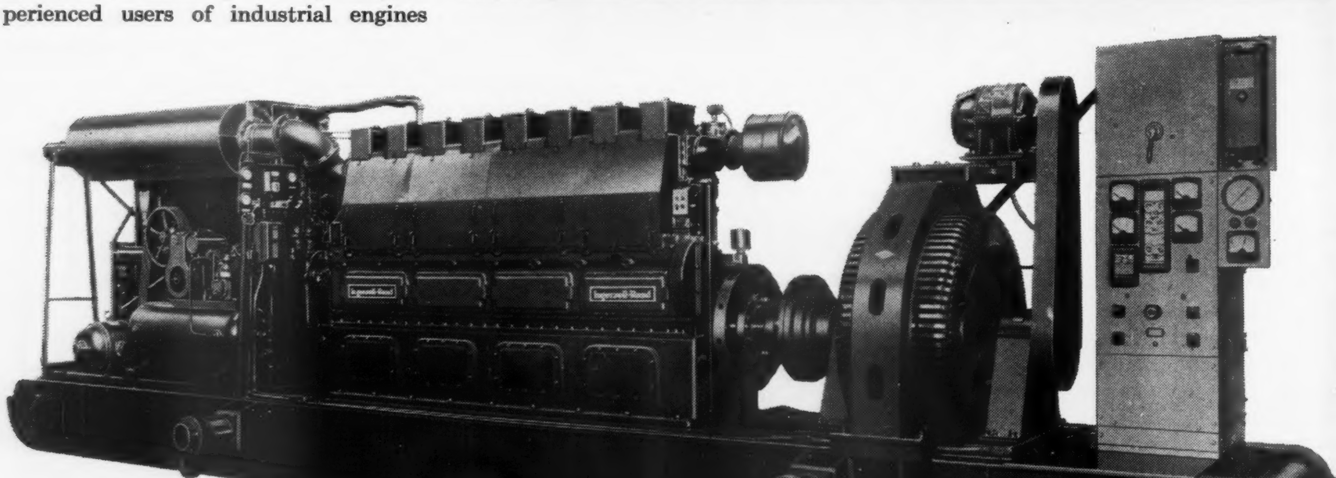
The superiority of the closed over the open cooling system has been well established, and in the past ten or fifteen years there has been a decided trend towards the former. More recently, the use of fan-cooled radiator sections seems to be on the increase. Where it is of prime importance to save as much water as possible, or where engines must operate unattended for long periods, radiators are a necessity. In any case, experienced users of industrial engines have found that, in the long run, open cooling systems, despite their low first cost, are expensive and troublesome and that properly designed closed systems pay for themselves.

The points brought out in the foregoing discussion on cooling methods for internal-combustion engines also apply in general to the cooling of air or gas compressors. In this connection, H. D. Krummell, chief engineer for the Chicago Industrial Division of Socony-Vacuum Oil Company, says, "Our field lubrication engineers check the operation of hundreds of air compressors. I do not think it can ever be stressed too strongly or too often that clean air and clean water jackets are essential to good performance. We find time after time that the troubles blamed on the lubricant used are really the result of neglect of these two items."

"PACKAGED" PORTABLE UNITS

For special services, machines that are ordinarily stationary are sometimes made up into portable units with cooling systems and all other accessories on one base. During the late war, nine skid-mounted power plants like that shown at the bottom were built by Ingersoll-Rand Company for the U. S. Army Engineers. Each consisted of an 8-cylinder diesel engine driving a 400-kw. generator. A radiator for cooling jacket water and an air compressor for starting the engine are at the left end, and a control panel is at the right end. The bases were designed so that the assembly could be dragged over roads and were equipped with lifting lugs for loading and unloading. Total weight was 55,000 pounds. Packaged compressor units that can be moved from place to place are gaining in popularity in oil fields. The upper picture illustrates such an assembly, one of the eight sizes made up by Wilson Supply Company of Houston, Tex. Units are composed of Ingersoll-Rand Class ES-1 compressors driven by Waukesha gas-gasoline engines. In this particular case, two compressors have been combined to form a 2-stage plant. The radiator for cooling the jacket water of both engine and compressors is at the upper-right.





Fishing with a Wagon

The Strangest Thing About This Seemingly Incredible Yarn Is That It Is True

THE CLEANUP

Many of the enmeshed fish fall to the ground when the nets are shaken. Most of the others can be reached by standing in the wagon. Those still higher are gathered with the aid of a ladder. The men in the circle are Carl Burbine, left, and Edmund Brine with some of their catch. The fat shad average 2½ pounds each and are considered one of the tastiest of fishes. Towards the end of the summer salmon is taken in the same way but in fewer numbers.

ONE of the strangest forms of commercial fishing in existence may be witnessed from mid-May to September at the head of the Bay of Fundy, where the Isthmus of Chignecto joins Nova Scotia and New Brunswick. Here, where the tremendous tides rise and fall as much as 30 feet, fishermen drive a horse-drawn wagon 3 miles from shore at low tide and then climb a ladder to recover fish that were caught in elevated nets when the water was coming in.

In this Cumberland Basin, men have fished in this unique manner for about 90 years. The industry formerly supported several families in the tiny village of Minudie, but now only one group of seven follows the calling. Four of them are named Brine and three are Burbines. During the early part of the season shad are running—shad that average 2½ pounds and are so fat that they may be fried without adding grease. Later in the year salmon come in, but in much smaller numbers.

Adapted by permission from an article in *Imperial Oil Review* published by Imperial Oil Limited, Toronto, Canada.

This is a stern way to earn a living—a routine of hard, unremitting toil, of little sleep, and of considerable danger. Twice every 24 hours when the tide drains from the basin the nets have to be cleared and put in order for the inward rush of water that will rise 28 feet or more in a 6-hour period. Because the tidal schedule changes from day to day, the fishermen's working hours necessarily change with it. Whether low tide is at noon and at midnight or at dawn and dusk, they go out. Only a storm of serious proportions keeps them home. They accept rain, fog, biting cold, and scorching sun with a shrug of the shoulders.

Owing to the long and intermittent working periods, the men eat five times a day and sleep whenever they can. Some hours before the receding tide bares the mud flats, they sit down in Edmund Brine's house in Minudie to a meal that may consist of cold pork, boiled potatoes, cookies, and cake, washed down by strong tea. Rising from the table, they hitch Queenie and Bob to a box wagon loaded with stakes, mallets, ropes, and nets. Then they start for the shore 6 miles away where a cluster of weather-beaten frame huts, that they call their "camp," huddles behind a dike that keeps the sea from flooding the marshland to the rear.

At the camp the horses are unhitched and permitted to graze on the rich marsh hay while new guy ropes are spliced to replace those frayed by the surging tides. Peter Brine makes tea and, when it is ready, the fishermen have a snack before the animals are again put in harness. Edmund Brine takes a ladder from the side of a hut and adds it to the load in the wagon.

As the men and team climb over the dike, a strong southwesterly wind greets them, blowing up the Basin and bringing mist with it. Ahead of them stretch desolate red mud flats, with a curving line of stakes disappearing in the distance. The stakes mark the route the wagon must follow to the nets, about 3 miles away. For the first 300 yards sticky gumbo clutches at the horses' hooves and the fishermen's rubber boots, but then the bottom firms, although the wind is blowing an inch or two of water over its rippled surface.

A mile from shore the fog closes in, blotting out the land. The men and horses plod on, following the guiding stakes, which are about 2 feet high and 15 feet apart. The wind, cold on the shore, is biting on the exposed flats. Suddenly the tricky mist lifts and discloses ahead a long line of nets strung at the tops of 12-foot birch poles rising from the sand and moored to stakes on both sides. The screams of seagulls are heard as they swoop upon the enmeshed fish. The men quicken their pace, for the birds can destroy dozens of fine fish, tearing them with their powerful beaks.

As the distance lessens, silvery specks in the nets become shad, caught fast by the gills and swinging as the nets belly in the wind. The need for a ladder is apparent, for while it is possible to grasp the bottom of a net the top is well beyond reach. This is the main string of 18 nets, each 23 yards long. Half a mile farther on is another string of ten.

The first job is to repair damage wrought by wind and water. Two of the 23-yard sections are down, trailing in the mud and water in a tangle of ropes and guy stakes. The three older men set out to restore them, while young Neil Burbine, with three companions on foot, drives the team to the lower string. No holes are dug to replace the fallen birch uprights. The men merely attach guy ropes to one of them at a time, set it up, and rock it back and forth. Soon its sharpened end penetrates the sand, and within a few minutes it stands erect. The guy ropes are then fastened to the stakes, and one of the crew, working from the ladder, swiftly stretches new nets on the poles and makes them fast.

As the men toil, the tide turns and inches up the gently sloping flats. Neil returns from the lower nets with a good catch, and he and Peter Brine walk along the main string, shaking and pulling the nets and gathering up the shad as they fall to the sand. Some are held fast, and Carl Burbine, following with the wagon, collects those he can reach, while Edmund Brine, using the ladder, harvests the remaining ones. A dozen or so have been badly torn by the seagulls and are tossed aside.

When the nets have been left behind, Edmund's trained eyes survey the fish in the wagon. "A hundred and fifty," he says. "A good catch." The horses have a harder pull as they follow the line of stakes marking the safe course to shore. Behind, the tide is rising fast. As the men walk, they straighten stakes that

REPAIRING DAMAGE

Waging a continual battle to keep nets in order, the men work feverishly to beat the incoming tide. With wooden mallets (left) they drive stakes for anchoring guy ropes. Above– The water is coming in fast and the wind is blowing hard as Edmund (on ladder) and Peter Brine unsnarl a twisted net and put it back in place on the 12-foot birch poles.

A DAY'S CATCH

Their silver-blue scales discolored with mud and sand from the flats, 150 shad repose in the wagon bottom for the 9 mile trip to Minudie. Before the men can rest, they must split, clean, and salt the fish away in huge barrels that hold about 400 pounds each and fetch around a hundred dollars.

are leaning or replace them with spares from the wagon. The stakes are of the utmost importance, especially when night ar fog obscures other guiding landmarks.

Edmund looks at the tiring horses. "That team travels 36 miles a day," he remarks. "It's six miles from home to the camp and three miles from the camp to the nets. That makes an 18-mile round-trip twice a day. I'm going to get a truck. Then we can drive to the camp and leave the horses there. This way we get only a few hours of sleep a day. After the team gets home we have to clean the fish. After that there's the farm chores and when we finish them and eat it's almost time to start out all over again."

The wagon rolls slowly through the gumbo near the shore, over the dike, and stops as Queenie and Bob relax and munch marsh hay again. Neil is left to drive them home; the others go ahead. Hours later, it seems, the wagon comes slowly into the barnyard. There the fishermen go to work again, for the shad must be prepared for market at once. "A good season," says Edmund. "A good season," Peter echoes as their knives split the fish. Next, they rub gleaming white salt on the split and cleaned shad and toss them into fat puncheons (large barrels) in the barn. Seven of the containers are full. Each holds about 400 fish that are worth approximately $100. The catch represents a month and a half of fishing.

As he works, Edmund casually discusses the dangers of this mode of fishing. Darkness, he says, keeps most men off the flats, but fishermen seem to be accustomed to its dangers. Formerly they used lanterns, but now they have an electric light from a dismantled automobile and take along two batteries, just in case. There have been some narrow escapes from death, and light is all important in darkness or in fog. Edmund, who has had several brushes with the fast-rising tide, puts it this way:

"When you're lost on the flats it isn't like being lost in the woods. You can't sit down and wait until the fog lifts or daylight comes to get your bearings. You've got to move fast and hope you're moving towards shore. If you lose your way, you haven't much of a chance.

"One foggy night," he continues, "I decided to take a shortcut back from the lower string of nets. I thought I'd pick up the line of stakes and save a walk of 500 yards. It didn't take long to find out I was lost and I knew the tide was coming in fast. I was up to my knees in water when I discovered I'd gone around in a circle, but just a few minutes later I managed to find the upper string. I got ashore all right, but it was too close for comfort."

Soon the last shad, cleaned and salted, is in the puncheon, but there is still more to be done. One of the crew brings a net bearded with dried marsh grass from the barn. It is strung up and attacked with brooms made of twigs, "waddles" to the fishermen. Working in unison, two of them brush the grass from the net, cleaning it so that its meshes will again catch shad and, later in the season, salmon. That chore finished, the men are ready for supper and perhaps a little rest before they start out again.

SPLICING ROPE

As they wait at their "camp" near the water's edge until the tide is low enough to go out on the flats, the fishermen pass the time making up guy ropes to hold the pole-borne nets upright. Left to right: Peter Brine, Wilfred, Carl, and Neil Burbine, Harry and Vernon Brine. Edmund Brine is missing from the picture. In the background, one of the horses grazes on marsh grass.

COMPRESSED AIR AT WORK

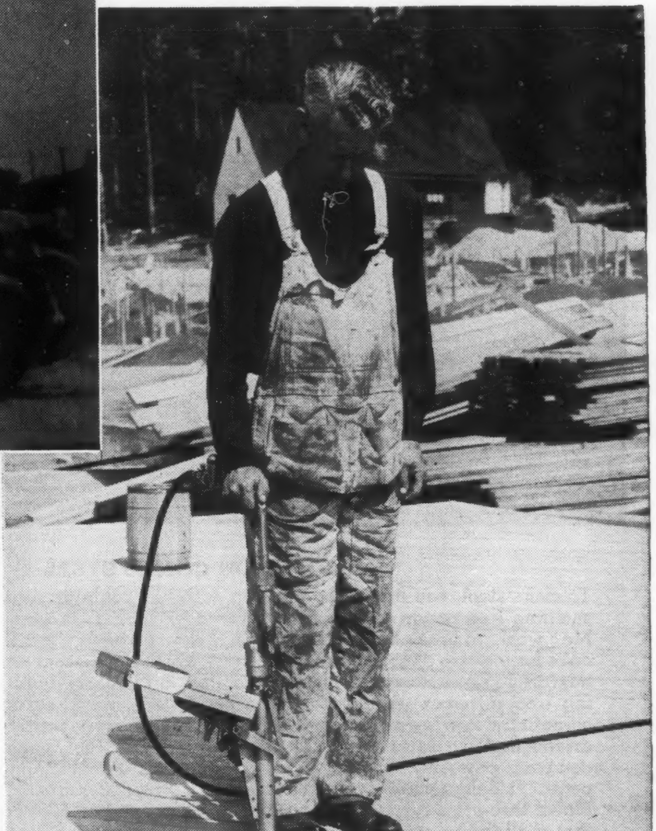
To move the 220-ton frame section of a Bucyrus-Monighan dragline used on a canal job in California, the Condick Company, of Berkeley, Calif., utilized the pneumatic-tired combination trailer and dolly shown above. As the structure was too large (42 feet wide and 30 feet high) to travel main highways, it was hauled over 30 miles of unimproved country roads and 30 miles of improvised roads that crossed open farmlands. All told, 66 Goodrich tires of 12- and 14-ply construction were required. Each of the 48 tires under the heaviest part of the load carried a weight of 8333 pounds. This special equipment made it possible to transport the 610-ton machine without dismantling it into relatively small sections.

Julian H. Harris, Atlanta, Ga., sculptor, is shown at the right executing one of four decorative limestone panels for the new Upson County Hospital at Thomaston, Ga. The panels, which depict various phases of medical science, are 6 feet high and 42 inches wide and will occupy wall spaces between elevated windows. Guided by half-size plaster models, Harris carves the stone with small chisels mounted in a pneumatic drill operated with compressed air at 65 psi. pressure.

PHOTO BY "ATLANTA CONSTITUTION"

To facilitate spraying his citrus-fruit trees with insecticides, Cecil Miller, of Pomona, Calif., developed the truck-mounted elevating platforms shown below. Telescoping steel tubes operated by a combination of pneumatic and hydraulic power raise the platforms to any desired height up to 35 feet and enable spray-gun operators to cover all parts of the trees, including their tops. The liquid insecticides are carried in the truck's tank body, and a compressor and hydraulic equipment are mounted with their controls within convenient reach of the driver's seat. Spraying with these outfits is said to be less expensive than from airplanes. City officials who have seen Miller's rigs at work are interested in the possibility of using similar platforms for cleaning and repairing street lights.

With the pneumatic nailer pictured below an average operator can drive 40-50 nails per minute and an experienced one up to 80. Designed primarily for work on sheathing or subflooring, the tool is actuated by a trigger handle and uses 12 cfm. of compressed air at 90 psi. pressure. The bottom of the 22-pound nailer is attached to the operator's right foot by a strap and is thus carried along and positioned for work. The hopper holds from 400 to 600 nails of 7-, 8-, or 10-penny size, and feeds them automatically. The tool is made by Azor Products Company, Los Angeles, Calif.

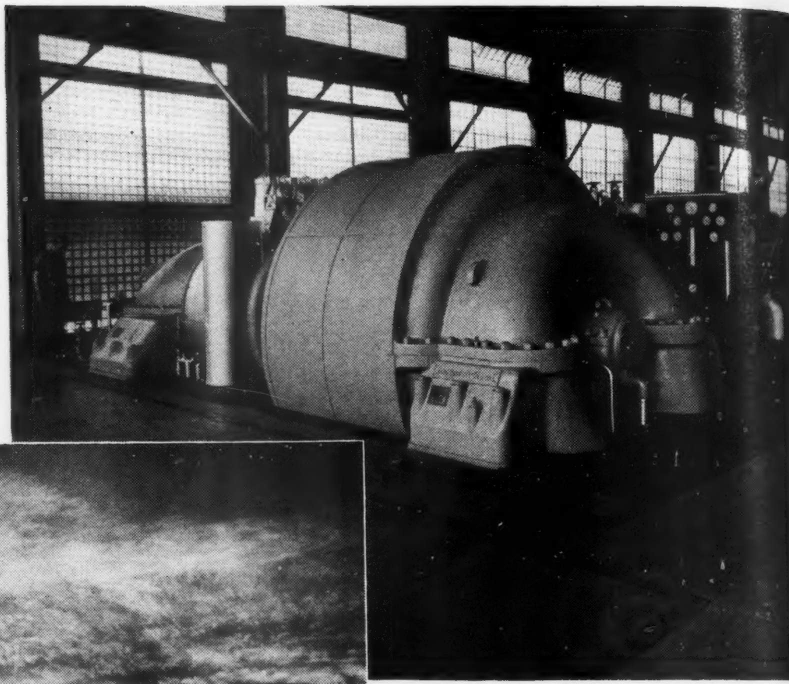


Using the rotating-disk principle originated by Faraday in 1831, Dr. Robert I. Strough, Case Institute of Technology physicist, (left) has developed a laboratory model of an air-driven electric generator that may lead to worth-while savings in constructing magnetic cores for betatrons and other atom-smashers. A stream of compressed air impinging against buckets cut in the side of a 5¾-inch beryllium-copper disk spins the wheel at a peripheral speed approaching 300 miles an hour. To facilitate taking off the enormous amount of electrical energy produced, "brushes" are jets of liquid mercury instead of the conventional solid-copper or carbon types. The machine is capable of developing a magnetic field 6000 times as great as that of the earth. For protection in case the disk should fly apart, Strough has encased it in a framework of steel and timbers.

COMPRESSED AIR AND GAS INSTITUTE PHOTO

Oddities of Steelmaking

More Air Than Iron, Plus Many Other Common Things, Are Needed to Produce Our Most Basic Metal



FROM IRON COMES STEEL

To make steel, you first make pig iron and then refine it. Pig iron is produced by smelting iron ore in towering blast furnaces such as those at the Sparrows Point, Md., works of Bethlehem Steel Company shown above. Ore, limestone for flux, and coke for fuel are charged into the furnace top and a blast of air is blown through the mixture to furnish oxygen for combustion. In the early days, small charcoal-burning iron furnaces were blown with hand bellows. Then came blowing "tubs," essentially low-pressure compressors with cylinders made of wood staves and driven first by water and later by steam. Today the "wind" comes from sleek, compact, powerful centrifugal blowers such as the one pictured at the top of the page. It delivers 100,000 cfm. of air at 30 psi. pressure. The weight of the air blown through a furnace amounts to 4 tons per ton of steel produced and exceeds that of all the solid materials in a charge. In a year the nations' blast furnaces consume 200,000,000 tons of the earth's atmosphere.

A BIG steel company buys lots of suet, molasses, salt, and bran not for its cafeteria but to help run its mills. You think that's an oddity? Well, one of its executives, who's really ready for anything, had to sell not only a whale but an amusement park! Dozens of such unusual things occur in the fascinating business of making iron and steel which, since their first recorded use almost 6000 years ago, have had a vital and ever-widening influence on man.

From caveman times, when iron was crudely pounded or forged with rocks, to the twentieth century with its mighty blast furnaces, steel has paced civilization. It has given man his trains, planes, and ships; his skyscraper cities and household articles that increase his comforts; his machinery, surgical instruments that lengthen his life, and agricultural equipment with which to till the soil. While the status of some metals has changed little through the ages, the story of steel has grown more fabulous all the while. And as scientists plan rockets to the moon and steel spheres penetrate the ocean to greater and greater depths more chapters are still to be written.

Early applications of iron were interesting but not significant. The Egyptians wore iron beads about 4000 B.C. Later the same people, famous for their mummies, used a crooked iron instrument in their elaborate process of preparing a body for interment. Ancient hunters fashioned iron into spearheads. Bold knights who set great store by their steel swords and armor quaffed powdered-iron drinks in the belief that they gave them strength. The Scythians made sacrifices of cattle, horses, and human prisoners to an iron saber that served as the symbol for Mars.

For a time the metal was believed to possess mysterious qualities and regarded with superstition. An iron nail was hammered into a tree to quiet a toothache. Some people thought an iron ring would "draw out" rheumatism. An iron horseshoe graced the mast of Nelson's victorious flagship at Trafalgar. The Roman author Pliny wrote that nails extracted from a tomb would "prevent nightmare" if driven into the threshold of a door.

Iron was once so scarce it ranked among the treasures of the wealthy. A king considered his pots and pans to be as valuable as his crown jewels. Emperor Rudolph II of Augsburg is said to have ruled from an ornate throne of iron made in 1577. Under old methods it cost 20 or 30 times as much to make a ton of iron as it does today.

Varied were the uses found for iron. Warriors put a highly polished piece of iron as a rear-view mirror on their horse-drawn chariots. Twelfth-century Russian tribesmen had shoes with iron

soles. Needless to say, the latter wore so well that they were sometimes passed along for several generations.

In the 1860's, steel collars were the rage for both men and women in the United States. White enameled, they could be cleaned with a damp cloth—laundering was unnecessary. They cost one dollar. Hoop skirts were also in vogue. Steel bands, 14 feet in circumference, were advertised as having "wonderful flexibility, strength, and natural elasticity."

Iron has served even as money. A bar weighing about 11 ounces was once the "pound sterling" of Britain. A rich member of the Bongo tribe in Central Africa couldn't lift his own wealth—the coins being iron disks as big as 12 inches in diameter. In America, tenpenny nails were used as money in Colonial days, ten nails being worth a penny.

Another curious side light in the history of the metal is the age-old secret of ironmaking in India. The famed iron pillar of Delhi still doesn't rust although it was forged more than 1600 years ago. The process was lost through the years, and it was centuries before iron of as good a quality was again produced in India.

Blast furnaces, which today are given prosaic designations as "No. 1" or "No. 8," were once named after ironmasters' wives or children like Sarah Ann, Little Belle, and Matilda. Elizabeth Furnace and Charming Forge were operated in eastern Pennsylvania by the fabulous "Baron" Henry William Stiegel who, in the eighteenth century, built himself a castle and had a cannon fired from its towers to salute him upon his return from trips. The Pennsylvania "iron plantations" of that age were almost feudal in character, with about 1000 persons working for an ironmaker who more or less directed their mode of living. Now, nearly 40 percent of the jobs provided by the nation's manufacturing industries are attributable to the products of steel mills. Even the making of toys for children calls for about 100,000 tons a year.

By weight, it takes more air than actual raw materials to produce a ton of pig iron—4 tons being required as against 3½ tons of coke, iron ore, and limestone combined. In one year, the country's blast furnaces thus consume more than 200 million tons of air. Water likewise is a necessity—the industry using five billion gallons daily.

In one year steel mills buy around 25,000 tons of palm oil which is obtained from distant places like the Belgian Congo. The oil is valuable both as a protective coating and lubricant in manufacturing cold-rolled steel and tinplate. The latter also calls for the use of bran, which is sprinkled on flannel-covered rolls to absorb the palm oil and to add luster to the surface of the plate. Once the bran has served its purpose, companies like Bethlehem Steel sell it back to cattle-feed firms who, in turn, dispose of it as fodder for livestock.

Soap is applied as a lubricant in drawing wire through a die. Suet is another good lubricant and is used in nut- and bolt-making machines. Salt comes in handy in rolling steel plates. It's thrown on the hot metal to remove hard scale—water in the salt, which is converted into steam with explosive force, knocking the scale loose.

Large quantities of gooey molasses and corn syrup serve as binders in forming sand molds in iron foundries. Another item in demand there is flour which is kneaded into dough to seal flasks; that is, the frames containing the pattern and sand mold in which iron is cast. As purity is not a requisite, sweepings—the flour that falls on the floor in bakeries—is suitable. A compound with a lanolin base, a fatty grease from the wool of sheep, is still another familiar substance in steelmaking. It is applied to sheet steel as a rust-inhibitive coating.

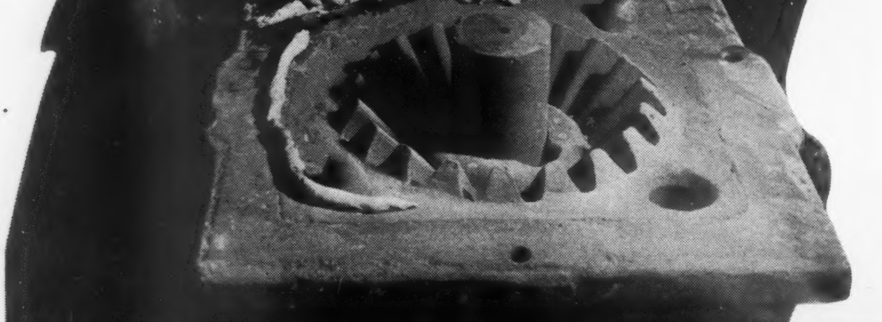
Diamonds, the industrial grade, are an essential in steel plants. They cost anywhere from $12 to $20 a carat. Noted for their hardness, they are used for numerous purposes such as "dressing up" dies. A humble material with the impressive name of diatomaceous earth is among the products bought by steel mills. Found in California and other places, it is formed of the silicified remains of microscopic marine life. Its most important application is as a heat-retaining agent in the controlled cooling of alloy steel to prevent dangerous thermal stresses.

EVERYBODY USES STEEL

Steel, the basis of our economy, is used in countless ways. On the dressing table of the lady pictured are three articles made of tinplate, which is sheet steel with a thin film of tin to prevent corrosion. About 100,000 tons of steel go into toys every year.

SOAP, FLOUR, AND SALT

Many commonplace household commodities enter into the ramified processes of making steel. For example, powdered soap lubricates the dies through which wire is drawn (right). Ordinary flour dough serves to seal openings in sand molds for making castings (below). When salt is thrown onto hot steel plates emerging from rolling mills (bottom) its water of crystallization is converted into steam with such suddenness as to cause explosions that knock off the hard scale.



Besides oddities that crop up in the purchasing department of a big steel company, the miscellaneous sales division has to be ready for unusual assignments. That of the Bethlehem Steel Company had a whale on its hands one day. The creature had floated up on the beach of one of the firm's Pacific Coast shipyards. After much searching, a tallow dealer was finally located who was happy to buy the whale for the fat.

On another occasion, the division had to ponder the problem of an amusement park acquired through the purchase of additional land for Bethlehem's Sparrows Point, Md., plant. Company executives wound up by selling the facilities here and there—one of the buyers, an operator of a similar concession, was glad of the chance to pick up a spare roller coaster and a merry-go-round.

By-product coke plants at the steel mills, which once wasted chemical compounds in the form of gas, now recover and refine them by distillation. These derivatives serve as raw materials in the production of numerous consumer articles such as nylon stockings, saccharine for sweetening tea or coffee, moth balls, perfumes, vitamin pills, aspirin, delousing compounds, sulfa drugs, rubber tires, flavoring for candy, fertilizers, shoe polish, and other assorted items. In fact, the entire synthetic-dye industry is based on chemicals from coal of which more than 200 million dollars worth are sold annually.

It is no oddity that steel mills and furnaces are now located in 30 states. The industry contributes in excess of eight billion dollars a year to the nation's income. From an inconspicuous start, steel has, with the passage of time, blossomed out into a mainstay of man's economy.

This and That

Taking the In Out of Inflammable

Peculiarities of the English language not infrequently lead to confusion. Take, for instance, the words "flammable" and "inflammable." Both mean the same thing, but official recognition of that fact has been slow in coming. In legal terminology the longer "inflammable" has persisted. Now, after 25 years, so the National Fire Protection Association reports, the Congress of the United States has given official sanction to "flammable." The word appears in recent legislation dealing with regulatory powers of the Interstate Commerce Commission. Also, the Civil Aeronautics Authority uses it in revised regulations governing the transportation of explosives and other dangerous articles. In due time, no doubt, all branches of the Government and even the courts will agree, as the dictionary has long proclaimed, that the two terms are interchangeable.

★ ★ ★

Record TVA Blasts

Three blasts set off by Tennessee Valley Authority engineers broke 3,285,000 cubic yards of rock for use in the South Holston Dam. Each of reputedly record-breaking proportions, one alone brought down 1,800,000 yards. The quarry site was a rounded elevation of sandstone and shale. After surface stripping, adits were driven into the base of the mound at 150- to 200-foot intervals and crosscuts, spaced 50 feet apart, were excavated at right angles to these entries. In places where the overlying stone was very thick, openings following this pattern were also made at a higher level.

Headings were 4 feet wide and 6 feet high and were advanced with drifter drills mounted on columns and bars. Tungsten-carbide bits were utilized with excellent results in the abrasive quartzite rock. Muck produced in the crosscuts was hand-loaded into wheelbarrows for transport to the adits, where it was slushed out by a tandem hoist-and-scraper setup. The three systems of galleries for the blasts involved 11,273 feet of tunneling. Explosives, consisting of du Pont Nitramon in cans, was placed in calculated charges at intervals along the crosscuts. Charges were connected by a single line of cans and fired with special primer cartridges by means of Primacord-Bickford instantaneous fuse. The total amount of Nitramon used in the three blasts was 2,686,292 pounds.

After the explosive was in position, the adits were filled with 8750 tons of sand stemming, which was blown through a 6-inch pipe by an air-operated concrete gun. Total cost of breaking the stone, including secondary drilling to permit handling all pieces by a 3-cubic-yard power shovel, was 39.6 cents per cubic yard. Loading, transporting, and placing the material in the dam cost 57.3 cents per cubic yard, giving an over-all cost of 96.9 cents per cubic yard.

★ ★ ★

Helicopter Hauls Dam Materials

In constructing a small dam on the outlet of Palisade Lake in the Province of British Columbia, Canada, the Greater Vancouver Water District flew in by helicopter all the materials used except the rock, which was quarried at the site. The structure, built in a gorge 40 feet wide by 30 feet deep on the east fork of the Capilano River, is of rock fill with an upstream face of reinforced concrete. By surface travel, the site is accessible only by a narrow 7-mile trail over rough terrain, with a rise of 1400 feet in the final 3000 feet. The heavy cost of constructing a road led to the adoption of aerial freighting. A landing "field," originally 10x12 feet and afterward enlarged at the pilot's insistence to 15x15 feet, was leveled close to the dam site by blasting the rock surface.

Following successful experimental flying in 1948, the project was carried out in 1949. The helicopter could transport a maximum of 400 pounds, and this was usually divided into two lots of 200 pounds each so as to balance the load. This required dismantling some machinery, such as a 1600-pound donkey engine. The heaviest piece flown in was the 410-pound lower bowl of a 5-cubic-yard concrete mixer. It was suspended underneath the helicopter's center of gravity. To set it down, a depression was blasted in the landing field and men guided the bowl to rest. All told, 1000 trips were made and 340,000 pounds of material and food was freighted at an average cost of 6.05 cents a pound.

★ ★ ★

Coats for Seeds

Relatively few of the millions of seeds in a pound of lawn-grass mixture produce plants. Each is so tiny that it has little room for the food and energy necessary for sprouting and full growth. When placed in cold, damp soil many of the seeds rot, others that sprout are killed by fungi before they can establish roots, and still others that develop shoots succumb to a plant disease called "damping off." To improve this situation, du Pont has produced a nonmetallic organic sulphur compound that forms a coating on the seeds to protect them until they can get a good start. Tests indicate that this treatment increases the number of healthy grass and clover plants by 46 percent.

BREAKING GROUND ON NEW JERSEY TURNPIKE CONTRACT

Paul L. Troast (center), chairman of the New Jersey Turnpike Authority, and William J. Brewster, president of the contracting firm of George M. Brewster & Son, Inc., look on as a Brewster employee operates an Ingersoll-Rand wagon drill to initiate work on a section of the turnpike near Laurel Hill in Hudson County. Starting in northern New Jersey near the George Washington Bridge, which crosses the Hudson River to New York City, the 118-mile, $220,000,000 superhighway will extend to Deepwater in the southern part of the state and on the Delaware River.

EDITORIALS

NEW GAS TABLES

IN THE year 1659, Robert Boyle, British natural philosopher, constructed his *machina Boyleana*, or pneumatical engine, and began to explore the properties of air. From his experiments came Boyle's Law, which proclaims that at constant temperature the relation between the pressure and the volume of a gas is constant. Or, to state it in another way, at constant temperature volume is inversely proportional to pressure.

In the main the law holds, but there are exceptions. For instance, natural gas doesn't abide by the rule. When it is compressed above atmospheric pressure, more than the equation provides for can be crowded into a vessel of a given size. The reason, physicists say, is that the molecules have an unusual attraction for one another and that this attraction grows as pressure increases.

This deviation from the law for ideal gases is referred to as supercompressibility, of which the reciprocal is superexpansibility. Because natural gas is an important commodity nowadays, the phenomenon of supercompressibility takes on commercial significance, and it is necessary to take account of it wherever the gas is handled under pressure. In all cases, the volume of the gas has to be corrected for the deviation that applies to its specific gravity, temperature, and pressure. Otherwise serious errors would result and, where the gas is being sold, the seller would probably get less than he had coming to him.

We have drawn upon the *Oil and Gas Journal* for the following specific example. Assuming that the gas in a pipe line has a specific gravity of 0.807, a flowing temperature of 43°F., and a flowing pressure of 1100 psi., the deviation-correction factor that applies to it is 1.304. Thus, while an orifice meter reading, uncorrected for deviation, might indicate the passage of 1,000,000 cubic feet of gas, the true volume is 1,304,000 cubic feet. That is a difference of 30.4 percent.

Inasmuch as the rate of deviation increases as pressure rises, the actual deviation from normal has to be figured out in each instance. Up to now this has been a tedious task. One engineer computed that, under the range of pressures, temperatures, and specific gravities dealt with in the gas-producing areas of the Southwest, as many as 700 million different combinations are possible. To standardize operations, the Natural Gasoline Association of America and the California Natural Gasoline Association compiled procedures for determining the factors of gas supercompressibility under all possible conditions.

These procedures have recently been reduced to tables that list factors for a wide range of conditions. They will lighten the engineer's burden just as interest tables have befriended bank workers. One gas company estimates that the elimination of numerous computations will reduce the time to one-twelfth that previously required for the purpose and also insure greater accuracy.

SUBMARINE'S BIRTHDAY

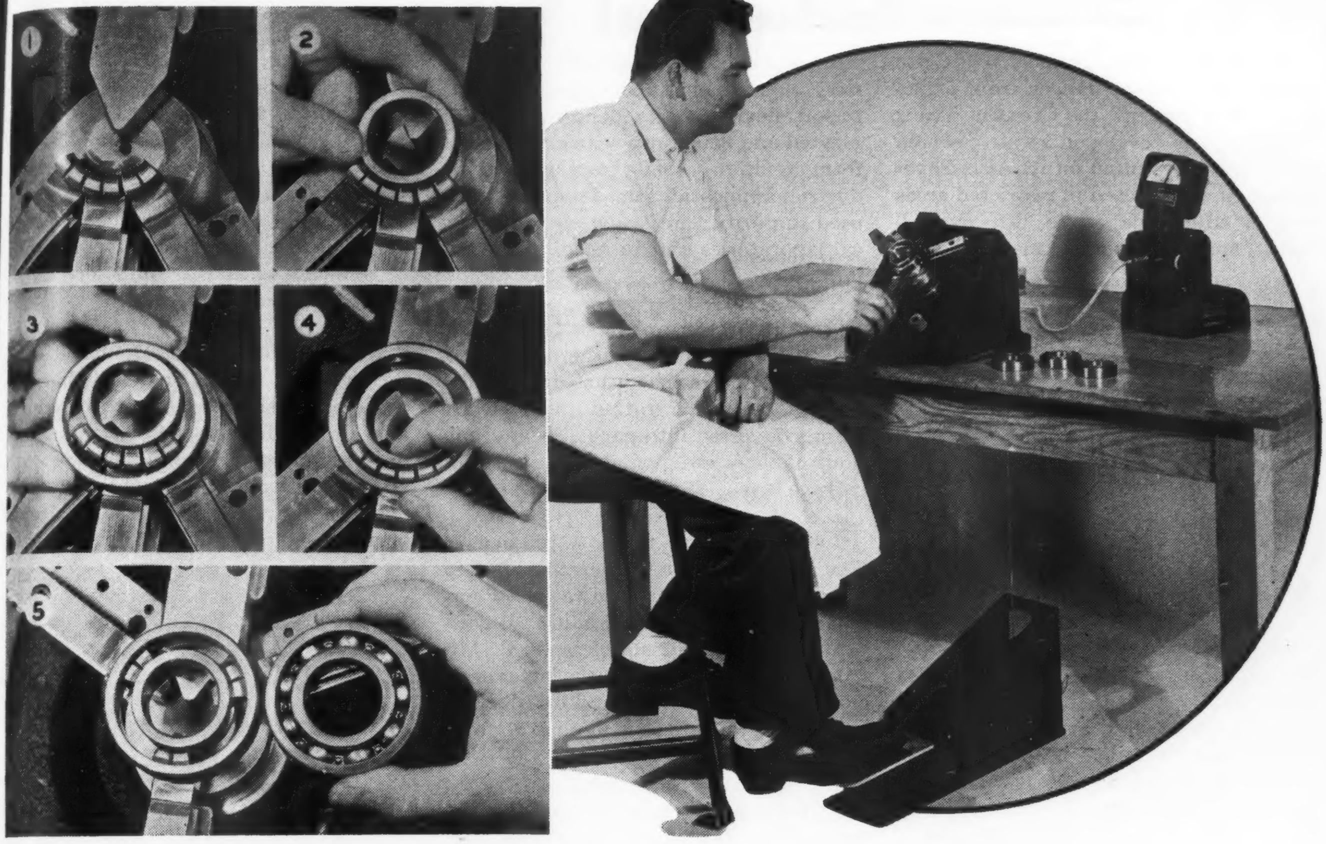
OUR article last month on uses of compressed air in modern submarines was well timed in view of the fact that April 11 marked the fiftieth anniversary of that type of craft in the United States Navy. Actually, however, the submarine is much older than 50 years. The idea of an underwater vessel was conceived as far back as the year 1620, and many workable models were constructed before our Government recognized the submersible as a practical tool of warfare.

The first submarine of record was built by Cornelius van Drebel, a Dutchman in the service of King James I. of England. Manned by twelve oarsmen, it is reported to have been navigated for several hours at a depth of 12 to 15 feet in the Thames River. Details about its construction and the provisions for submerging and supplying the crew with air are lacking. During the seventeenth and eighteenth centuries other inventors put forward either designs or actual vessels, but none attracted much attention until David Bushnell, fresh from Yale College, created the *Turtle* in 1776 in a futile effort to destroy the British fleet that was anchored in New York Harbor.

Bushnell's one-man wooden boat, propelled and steered by hand- or foot-operated mechanisms, held enough air to sustain the pilot for 30 minutes. It was submerged by admitting water through a foot-controlled valve and was surfaced by expelling water by working two brass force pumps. Lead ballast on the bottom could be released in an emergency to help the vessel ascend. Astern was a receptacle that held a keg of powder, and incorporated in the latter was a detonating device. Bushnell proposed to fasten the bomb to the hull of the British man-o-war *Eagle*, then withdraw to a safe distance while a timing mechanism delayed the explosion. His plans went awry when an iron screw, that was designed to be turned from within the submarine for the purpose of attaching the charge, failed to penetrate the *Eagle's* copper sheathing.

Robert Fulton built what he considered a successful submarine in Paris around 1800. That was the *Nautilus*, which even had compartments for storing compressed air with which to sustain the crew. It moved up and down by admitting or ejecting water stored in tanks, and carried a torpedo and mine equipment. Discouraged by the lack of interest the U. S. Government showed in his invention, Fulton turned his attention to the improvement of surface vessels and created the steamship *Clermont.*

The submarine finally accepted by our naval authorities in 1900 was designed by John P. Holland, who began working with submergible craft in 1875. A contemporary was Simon Lake, who sold his ideas abroad after the U.S. Navy turned them down. Holland's first boat, the *Plunger*, was approved by the Navy in 1888 but was not ready for delivery until 1895. However, dissatisfied with it after it was completed, Holland returned the money that had been advanced him and started to build the *Holland*. The latter was purchased by the Government in 1900, and five similar vessels were ordered.



THE INSTRUMENT AND HOW IT WORKS

Operation is on a production basis and proceeds as follows: 1, Three air spindles simulating balls are brought together in race loading position; 2, inner race is laid on top of spindles; 3, outer race is placed around inner race; 4, races are held by fingers in readiness for next step; 5, spindles are spaced equidistant by a foot-controlled mechanism as illustrated in the right-hand picture. The result is the same as a completely assembled bearing. The Selectionaire makes it possible to predetermine and to control radial-play tolerances from zero upward. In back of the instrument is a dial-type Precisionaire which indicates the size of the unknown element.

Matching Components for Ball Bearings with Accuracy

ONE of the most difficult problems in the manufacture of precision ball bearings is the matching of the inner and outer races and balls to produce an assembly with the specified radial play demanded by the customer. Today, it is common practice to classify the three components in 0.0001-inch steps, and to carry a considerable stock of each one. However, despite the most careful inspection, selection, and even teardown and rebuilding, allowable variations still result in bearings with an error of 0.0004 inch and more.

To insure a product of standard quality and at the same time lower manufacturing costs, Sheffield Corporation has developed an air-operated instrument that shows before assembly exactly how much space there will be for the balls between the races. Called Selectionaire, it serves both as an inspection instrument and gauge and is used in conjunction with the company's column or dial-type Precisionaire, which indicates the size of the unknown element—ball or either race—necessary to give an assembly with a predetermined amount of radial play. Just how the device operates can best be grasped by following the accompanying series of progress pictures. The principle upon which it is based promises to have a wide field of application wherever measurement or assembly of two, three, or more unknowns are involved.

Thin-Shelled Plastic Molds for Foundrymen

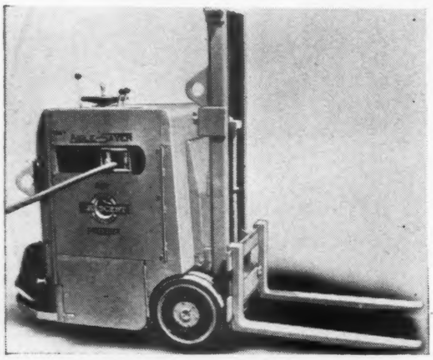
CONVENTIONAL sand molds in foundries may be on their way out, according to an announcement made at the National Plastics Exposition held recently in Chicago, Ill. The new molds that may take their place are made by a German process that is being developed in this country by the Bakelite Division of the Union Carbide & Carbon Corporation in coöperation with Crown Casting Associates which is licensed to use it in the United States.

A small percentage of sand is still required in forming the molds, but it is mixed with a thermosetting phenolic resin that is applied to the two halves of a hot metal pattern of the part to be cast. (The use of a metal pattern is also a departure from the usual practice.) The heat causes the plastic to melt and completely cover the surface to a thickness of about an inch. After being allowed to harden in an oven for a few minutes, the shell is stripped from the pattern and serves as the mold in which the metal is poured. As it is subjected to considerable pressure during casting, the shell is backed up in the mold box with steel shot.

The largest castings so far produced by the new technique weigh around 100 pounds and have proved that the plastic molds have many advantages over the bulky sand molds that have to be fashioned by skilled workers. Being light in weight, they are easy to handle, and they can be made ahead of time and stored for use. They are said to facilitate removal of the castings and to give parts a more accurate finish because their inner walls are smooth. In fact, Bakelite engineers expect to get tolerances from 0.002 to 0.003 inch.

Industrial Notes

For use in powder, chemical, paint, and other plants where danger from explosion is ever present, the Crescent Truck Company has developed an air-powered fork truck. Mounted on its Aisle-Saver chassis, it can be used in restricted areas and is adjustable as to lift, over-all height, and fork length to meet different



service requirements. Built in two sizes with capacities of 2000 and 3000 pounds, the truck is provided with 75 feet of ¾-inch hose on a retracting reel that gives it full maneuverability in about 18,000 square feet of floor space. It is operated with air at 90 psi. and consumes at the rate of 200-250 cfm. An added safety factor incident to the use of air power especially in enclosed areas is that the exhaust from the motor considerably improves ventilation.

What is described as a highly effective, low-cost filter that may help smog-ridden cities combat the nuisance of factory smokestack gases has been announced by the Atomic Energy Commission. Developed by the latter for its Oak Ridge and other atomic plants where air is used to cool uranium furnaces, it serves to remove fine radioactive particles from the air before it is exhausted into the atmosphere. The filtering material was produced by Arthur D. Little, Inc., under contract with the Commission, and consists of a mixture of asbestos and ordinary papermaking fibers compressed into soft, flexible sheets. These are closely pleated and fitted into wooden frames to form a filter. Aside from general industrial application, the device might be used to purify ventilating air in biological laboratories and in hospital operating rooms.

Another waste product is being made to yield a revenue. Southern Research Institute reports that it has developed a process by which rotted rail ties are being converted into paper. Many millions of them are available annually for salvage.

Liquid Stainless Steel, a product of The Lockrey-Fater Corporation, is said to give materials the resistance to corrosion and the impermeability to moisture of 18-8 No.302 stainless steel. Microscopically fine flakes of the latter present in the fluid overlap and interlock as the coating dries. It is applied by dipping, brushing, or spraying.

To keep rubber boots in condition for use and to prolong their service life, Mann Engineering Company has designed a so-called Boot-Vent that is available in sizes from 8 to 12 inclusive. It consists of a tapered leg piece and a foot piece made of stiff aluminum plates which are hinged together, forming a partition that keeps boots in shape to prevent wrinkling and cracking and permits free circulation of the air to hasten drying.

Trucks or buses making emergency stops at night have been the cause of serious accidents even though only a few minutes were allowed to elapse between the time they were brought to a halt and flares were set out to warn traffic traveling in the same direction. To eliminate this time lag, a Denver, Colo., firm has invented a signal light that the driver can operate from his seat in the cab while his vehicle is in motion. Through the medium of compressed air, which he controls by a trigger on the dashboard, the light is turned on and shoved out from the side of the truck for a distance of 15 inches so that it will be plainly visible to oncoming motorists.

Merrill Brothers has announced an addition to its line of materials-handling devices. Designated Adjusta-Clamp, it has all the features of the company's drop-forged lifting clamp plus a movable gripping jaw and means whereby an object can be raised from the horizontal position and placed in a vertical position

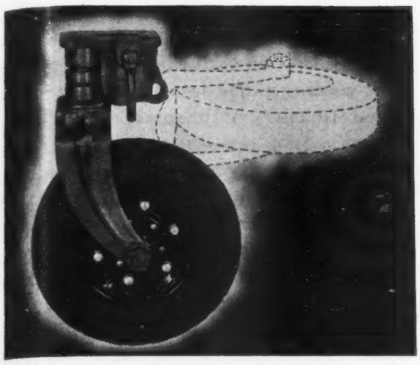
without adjustment. Two sizes with rated capacities of 1 and 3 tons are available. Standard type handles any metal object up to 12 inches thick that the jaws can grip.

One of those things that are so simple that one wonders why they have not been thought of before is a level that sticks to ferrous metal surfaces like a leech to leave hands free for work. The tool is called Magno Level and has been put on the market by The Buckeye Plastic Corporation. It has an aluminum frame, a clock-faced gauge that determines any angle from zero to 360 degrees, nonbreakable windows, and permanent Alnico magnets that hold it in any position on flat or curved surfaces. Measuring 9x2 inches, it weighs only 10 ounces.

Use of a new retractable landing gear introduced by The United Manufacturing Company converts a 2-wheel into a 3-wheel trailer that can be moved about or positioned by hand and anchored firmly when unhitched from its truck.

FACTORY REJECT WATCHDOG

The young lady is exhibiting an electric computor developed by General Electric Company and used on its refrigerator assembly line at Erie, Pa., to record rejects. Called the quality-control indicator, it counts the number of items produced and the number discarded and shows on a meter whether the percentage of rejections is above or below the acceptable level at any given time. Thus it becomes known at once when discards increase abnormally, and steps can be taken promptly to remedy the trouble. Ordinarily, statisticians analyze rejections and the figures lag behind production by hours or days, during which time costly rejection rates can continue undetected. Inspectors on the assembly line relay signals to the indicator by pressing buttons. The computor itself may be located away from the production line where it can be watched by a supervisor.



Attached to a single-axle tow, the assembly has an over-all height of 18½ inches when down. Wheel and fork can be retracted a full 90° and also swiveled 90° to clear road obstructions. A snap-action pin locks the gear firmly in place either up or down. Standard type is furnished with a 12-inch-diameter 3.50-x6 pneumatic tire of 2- or 4-ply construction having a load capacity of 315 and 490 pounds, respectively. Available on order with a 4x12-inch steel-tired wheel.

If you are using several kinds of hose for different applications, you can scrap them and confine yourself to one, says the Carlyle Rubber Company, Inc., 62 Park Place, New York 7, N. Y. It has announced what it calls a Vari-Purpose hose that is said to be suitable for handling water, gas, compressed air, oil, grease, paint, insecticides, alkalies, solvents, etc. It is made in sizes ranging from ¼ to 1 inch, inside diameter, and for a maximum pressure of 300 psi. Samples are available.

By fireproofing the structural-steel members in the new 35-story Mercantile National Bank Building in Dallas, Tex., with vermiculite plaster instead of concrete, the engineers are said to have reduced the weight of the structure by more than 15,000 tons!

Protection for pumps when discharge is cut off by mechanical failure, dropping of the water table, or other cause is offered by a device called Protectrol announced by Automatic Control Company. It automatically stops pumps when such emergencies arise and energizes an audible alarm and warning light. Units remain inoperative until manually reset. The device, which can be installed on existing or new pumping systems, can be used independently or in conjunction with controls for automatically starting and stopping pumps.

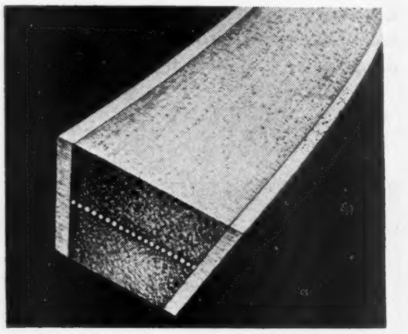
A corrosion- and oxidation-resistant coating with properties that make it suitable for use on metals, concrete, wood, fiber, and other materials that require more than normal protection has been put on the market by End-O-Rust, Inc. Applied without special surface preparation, it dries by air in two to three hours and by infrared baking in three to five minutes, forming a hard, glossy finish that is said to withstand dampness, humidity, and salt spray, as well as caustic soda, ammonia, and sulphuric, nitric, acetic, and hydrochloric acids.

A triple-purpose window fan designed primarily for home use has been introduced by the Fresh'nd-Aire Company, a division of the Cory Corporation. Designated as the Model W 800, it features a frame of plastic construction attached by a retention spring to a special bracket which can be adjusted to fit any stand-

ard window. So mounted the fan can be used as a ventilator—either intake or exhaust—or, removed from the bracket, for spot-cooling purposes. A handle is provided to carry it around.

It takes hardly any time, it is claimed, to open up a clogged pneumatic atomizing nozzle of the special type being produced by Spraying Systems Company. It is provided with a clean-out needle which, by pushing a plunger end at the rear of the nozzle, clears the orifice passage. Normally, the needle is open under spring loading; it returns to that position when the plunger is released. It is an integral part of the nozzle assembly, which is available in brass, stainless steel, and monel metal.

Two outstanding features are claimed by Chas. A. Schieren Company for its new-type leather V-belt for single and multiple drives: one is great resistance to stretch; the other that it can be spliced endless right on the sheaves. Stretch is minimized by a built-in Tension-Guard consisting of a row of rayon cords bonded between the leather plies. Splicing is done by means of a scarfed joint and the company's own Duxbak waterproof cement which bonds the ends of the rayon



cords, making them endless. Mechanical fasteners can be used for the purpose. Schieren E-Z lap cutter and lap press facilitate splicing and cementing: the former cuts the belt on the bias, making a long cut with a fine feather edge to insure a smooth joint, and the press dries the cement after application. Belts can be placed directly in the grooves under any desired tension without dismantling the drive.

Potent is the only word that describes a bracer or additive for cutting and lubricating oils and grease if it really makes them do all that is claimed by the manufacturer, Power Ball Oil Company, Inc. According to the latter, its new Frictionproof Oil gives them increased lubricity, lengthens their period of usefulness, and enables them to withstand pressures that would normally cause them to break down and moving parts to freeze. Lubricants so treated penetrate into the pores of metals, protecting them against corrosion, scuffing, and scoring. Because of this they easily free nuts and bolts,

shafts, valves, and other badly rusted machine parts. They also have detergent properties, dissolving carbon, gum, and sludge and holding them in suspension indefinitely. The additive is noninjurious to any metal, and oils containing it can be used as effectively in a fine watch as in a giant diesel. Referring to their effect on the machines themselves, the company claims that they prolong their service life, increase production, reduce the number of breakdowns and fuel consumption, and cut the cost of maintenance.

Industrial Literature

A new type of tubular dust collector for flue gases is the subject of a bulletin made available by Prat-Daniel Corporation, East Port Chester, Conn. The equipment is said to collect a higher than normal percentage of the fine particles.

Electromode Corporation has issued two bulletins containing descriptions, specifications, typical applications, and other information about its all-electric wall, portable, and unit heaters. Copies can be obtained from the company at 45 Crouch Street, Rochester 3, N. Y.

Information on Fiberglas insulation is given in a 16-page booklet obtainable from Owens-Corning Fiberglas Corporation, Toledo 1, Ohio. It describes all forms of this type of thermal insulation for industrial and building purposes and gives data on the material's thermal conductivity and sound-absorption properties.

Ledeen Manufacturing Company, 1600 South San Pedro Street, Los Angeles 15, Calif., will send upon request a copy of a catalogue describing its line of pneumatic and hydraulic actuating cylinders. Publication gives complete information on dimensions, weights, ratings, and limitations of cylinders and rod and head attachments.

Bausch & Lomb Optical Company, Rochester 2, N. Y., will send upon request a copy of a new catalogue describing its laboratory microscopes. Construction and operational features of each are dealt with, and accessories for the work of microscopy are listed. The publication also contains information about an inexpensive model recently introduced by the company.

Spence Engineering Company, Inc., Walden, N. Y., will send to interested persons a 6-page folder describing its temperature regulator. Designed for use with both storage and instantaneous steam-operated heaters, the device varies the steam pressure in definite steps in response to very small temperature changes at the thermostat bulb, resetting itself after each change.

Publication GEA-5401 of General Electric Company, Schenectady 5, N. Y., describes its new integral-horsepower motor that is designed for use where single-phase operation is demanded. Two types are available in ratings from ½ to 5 hp.: capacitor-start for 115-230 volts and capacitor-run for 230 volts only. Bulletin is obtainable upon request.

Iron-clad floors for industrial, commercial, and institutional use are dealt with in a booklet put out by The Master Builders

Company, Cleveland, Ohio. Consisting of concrete having a ⅛-inch-thick layer of iron particles embedded in the upper surface, the floor is said to wear longer, clean easier, and cost less than a plain concrete floor. Booklet is obtainable upon request.

A Planning Guide to Improved Plant Lighting is the title of a booklet available without cost to persons concerned with industrial lighting problems. It points out the benefits of adequate lighting systems and gives methods by which new ones can be planned and old ones modernized. Copy can be secured by writing to Benjamin Electric Manufacturing Company, Des Plaines, Ill.

The Alemite Versatal pump, which is designed to spray almost every kind of liquid from the lightest to the heaviest, is dealt with in a brochure put out by the Alemite Division of Stewart-Warner Corporation. Paint, adhesives, sound-insulating materials, calking compounds, and gear grease are just a few of the substances the unit can handle. Request for a copy should be sent to the company at 1826 Diversey Parkway, Chicago 26, Ill.

Ball-bearing, swivel-type pipe couplings are the subject of a catalogue which can be had by writing to Gil-Lair Products, Inc., 81 Masonic Court, Pasadena, Calif. The publication discusses eight basic styles in sizes from ⅜ to 12 inches and for pressures from vacuum to 12,000 psi. Other products dealt with are steel rotary hose, steel cementing hose, mud-mixing guns, marine and barge hose, and steel circulating heads.

Switchboards for public and private utilities, industries, and institutions are covered in Bulletin 18B6149A obtainable from Allis-Chalmers Manufacturing Company, 1000 South 70th Street, Milwaukee 1, Wis. Custom built to meet specific needs, the units use standard relays, meters, rheostats, and controls. Types described include duplex switchboards for centralized control, benchboards for concentrated control of meters and relays, and control cubicles for rectifier auxiliary equipment.

Kunkle Valve Company, manufacturer since 1875 of bronze valves for air, steam, gases, vapors, and liquids in a wide range of pressures and temperatures, has recently acquired the facilities of the Star Brass Company and has added that firm's line of cast carbon- and alloy-steel safety and relief valves to its own. All these are described in a new catalogue obtainable by writing to 111 South Clinton Street, Fort Wayne 2, Ind.

A 32-page brochure which explains how to use aluminum paints to best advantage can be had by writing to the Aluminum Company of America, 661 Gulf Building, Pittsburgh 19, Pa. Grouped under three headings—metal, concrete, masonry, and similar nonabsorbent surfaces; weather-exposed wood; and interior heated surfaces and decorative uses—the pamphlet tells how to choose the paint for the surface for which it was formulated.

A 4-page flier describing a new line of cradle-mounted centrifugal pumps for process and refinery service is obtainable from Ingersoll-Rand Company, 11 Broadway, New York 4, N.Y. Built in four sizes, 1, 1½, 2, and 3 inches with capacities from 20 to 550 gpm. and heads up to 250 feet, the units are suitable for a wide range of uses, including reflux pumping and transfer service in the handling of propane, gasoline, butane, and other light distillates. Requests should be made for Form 7212.